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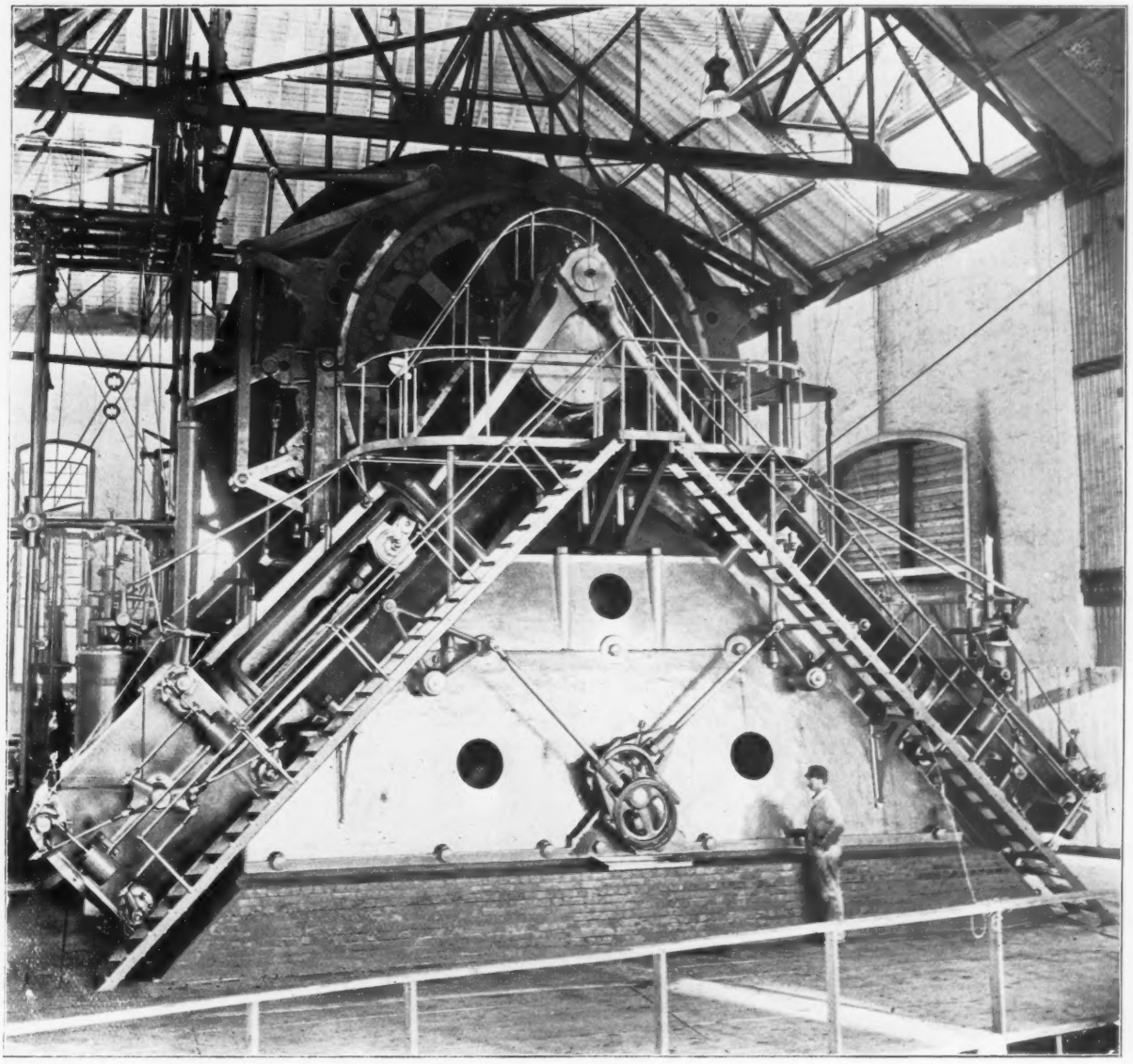
VOL. VIII. Philadelphia, April, 1904 No. 3.



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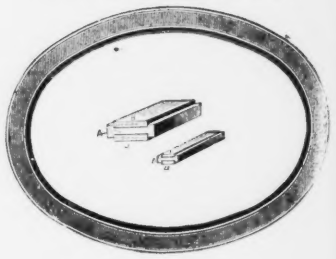

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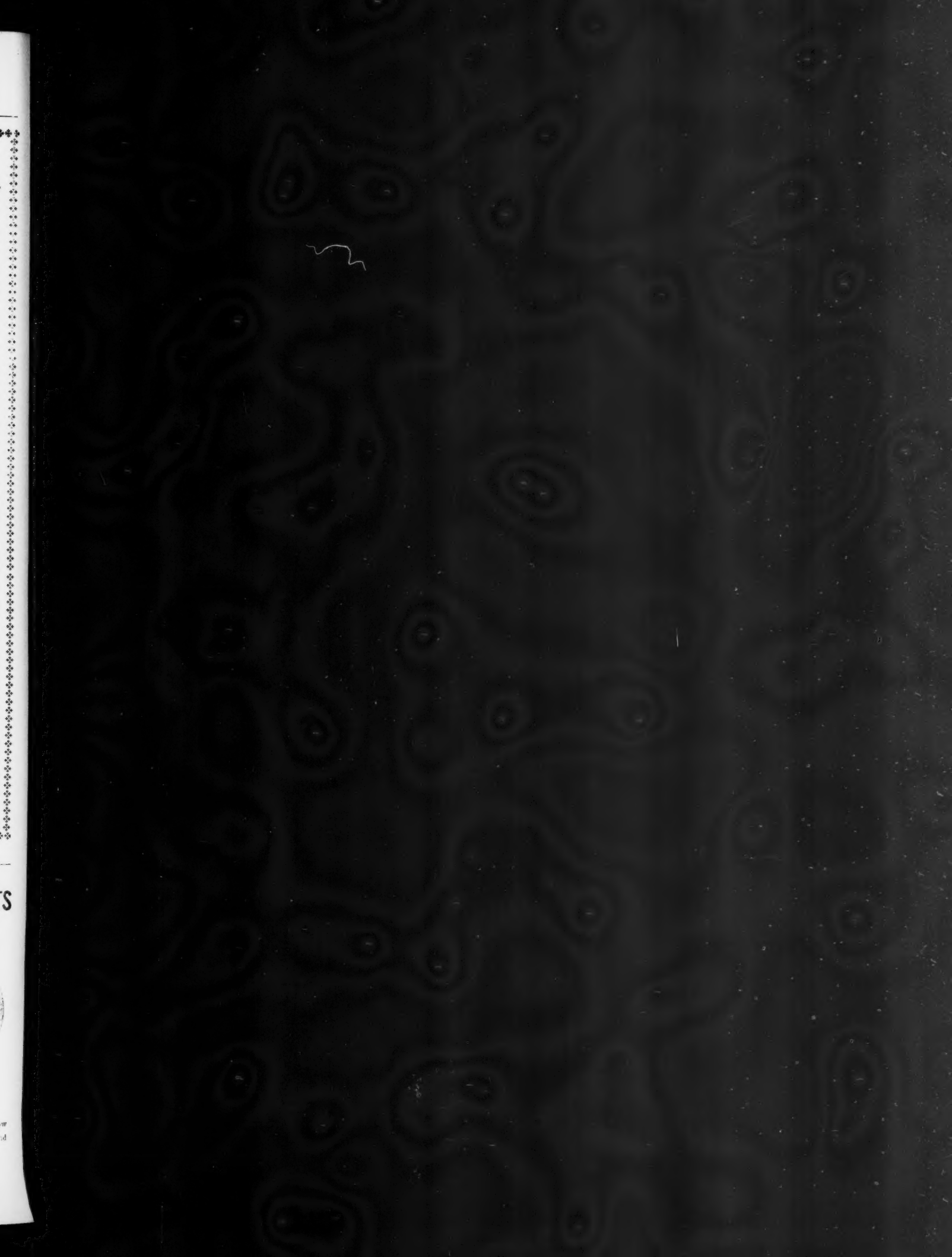

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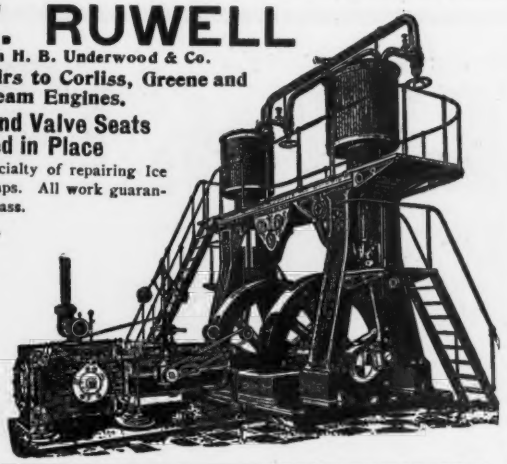

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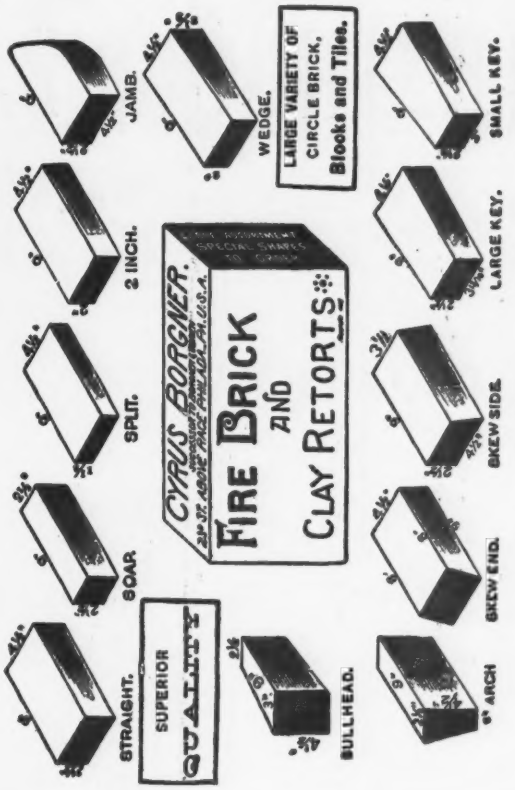

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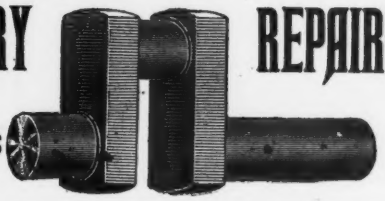

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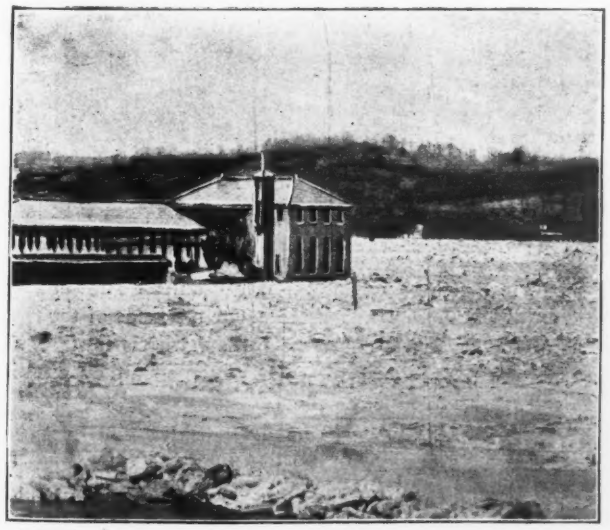
A monthly journal, devoted to the economical generation and utilization of power and to the interests of stationary engineers

VOL. VIII. PHILADELPHIA, APRIL, 1904. No. 3.

An Immense Power House Damaged By Ice

The Mammoth $1,500,000 Water Driven Electrical Plant at York Haven, Pa., Partly Destroyed

By a strange coincidence, just one month after the partial destruction by fire of one of the largest steam power houses in the south, on the seventh of February, the largest water power plant in Pennsylvania was partly destroyed by ice and water

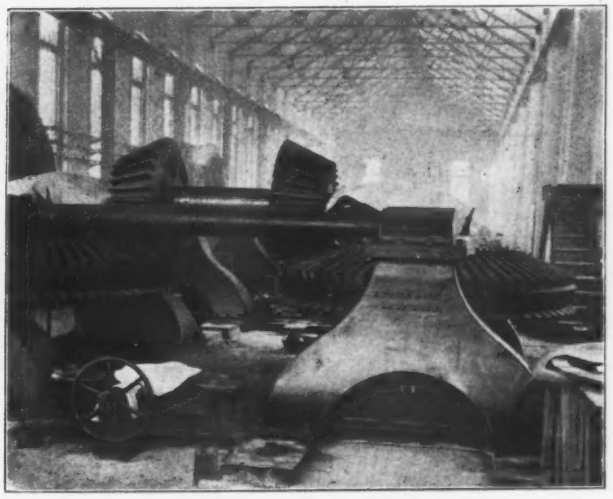


The Ice Gorge crushing down upon the Power House.

on March 7th. In both cases, the power houses were ruined by the elements intended to run them. In the latter case, thousands of tons of ice which had been lying in the river all winter watching the efforts of hundreds of men to complete the power house, rushed down upon its apparent enemy that was only awaiting the finishing touches to make it work and in a few hours almost destroyed the labor of the past few years. The completion of the plant had been considerably delayed by the severe winter, and never before in the history of the oldest inhabitant along the banks of the Susquehanna was there so much ice in the river and when this ice, raised upon the swollen river to an unprecedented height of 35 feet above low water level, crushed into the power plant, it carried everything portable with it, as well as part of the wall separating the forebay from the river and a greater part of the main building.

The York Haven Water and Power Company, to whom this plant belongs, was incorporated three years ago to supply electrical power to the surrounding industrial towns and up to the present time $1,500,000 has been spent upon the plant and machinery and $3,500,000 more has been raised to still further extend the building and install new apparatus.

Notwithstanding the damage done, which amounts to thousands of dollars, the plant is expected to be running within

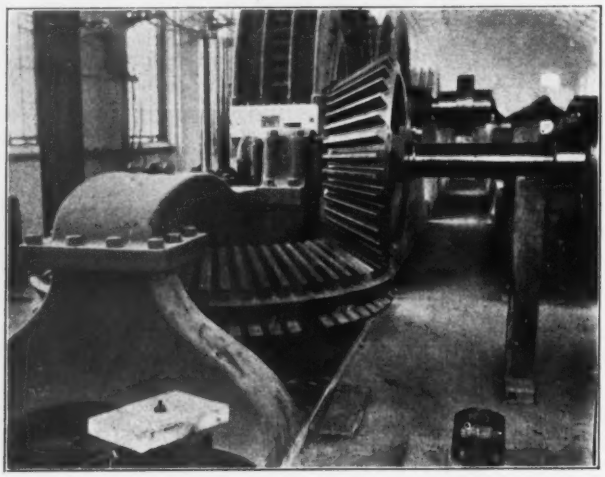


Interior of Power House, showing double bevel gear connection of the twin turbines.

a few months, so that a description of the plant as it was and will be may prove interesting.

It is situated on the west bank of the Susquehanna river, about sixteen miles from Harrisburg and eleven miles from

York, in the south central part of Pennsylvania, at the town of York Haven, a town of about 600 inhabitants. Until three years ago it was hardly known to the engineering world, but now contains the above-mentioned largest water driven power plant in Pennsylvania. At the place where the power house



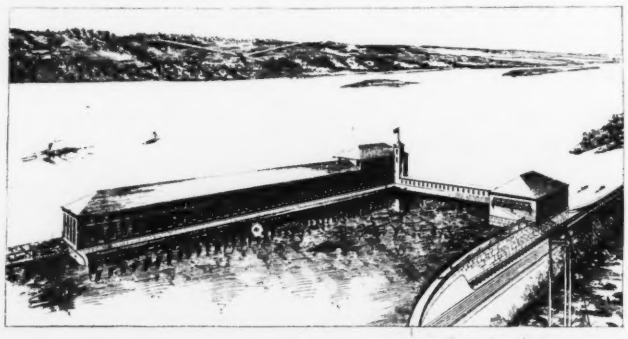
Singel bevel gear transmission from one of the small turbines to the exciter.

is situated, the river is over three-quarters of a mile in width and is one mile below the falls of the Susquehanna, which it uses as a head. A forebay extends from this falls, a distance of about 4500 feet, to the power house and is 500 feet wide, being separated from the river by an enormous masonry wall varying in height from 28 to 34 feet. The wall is 6 feet wide at the top and from 16 to 20 feet wide at the bottom. To construct this wall alone required 100,000 cubic yards of masonry. This wall is carried up to the falls where there is a large crib dam, 30 feet wide, 18 feet high and 3000 feet long built diagonally across the river to raise the already natural fall to a greater height. To insure a durable foundation for the power

Interior view, showing two of the 20-875 K. W. 2400 Volt Alternating Current Generators.

house and its massive machinery, excavating was resorted to far below the bed of the river so as to reach bed rock and secure a firm foundation. The building of the cofferdam was in itself no mean engineeering feat, as its dimensions were 500 x 240 feet, it taking 45,000 bags of sand, 250,000 feet of timber and 10,000 cubic yards of stone to build it before work on the building itself could commence.

The main structure of the power house, the generator building, is 470 feet long and 48 feet wide. It is very neatly built of granite, brick, steel and concrete and is one story in height, except at the south end which is two stories in height, the upper story being called the gallery from which all the machines are run automatically. The generating station is built for twenty 875 k. w., 2400 volt, 60 cycles alternating current generators, but at the present time only six units are installed; the others to be installed as rapidly as possible. Each generator is operated by two 79 inch turbine wheels of 550 H. P. capacity, each running in pairs and directly connected to the generators by means of bevel gears, these bevel gears being so constructed that one of the pair running together has mortised wooden teeth. There as also two 230 K. W. exciters operated by 62½ inch turbine wheels. The larger generators were built by the Stanley Electric Co., of Pittsfield, Mass., and generate their given voltage when running at a normal speed of 200 revolutions per minute, being geared up from the turbine shaft in the ratio of 4 to 1, the turbines running at a speed of 50 revolutions per minute. The smaller generators were built by the Northern Electric Co., and are geared to the

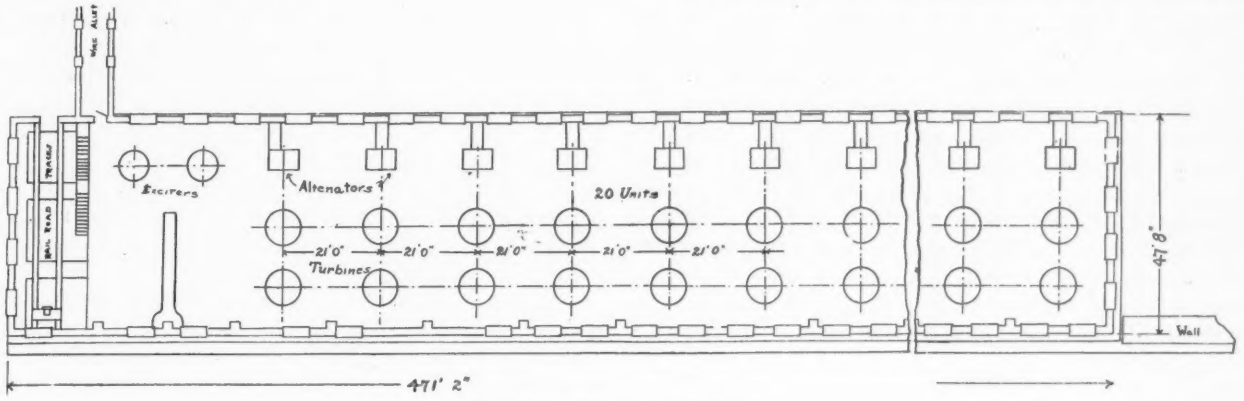


The York Haven Power Plant as it will appear when completed.

turbines in the same way as the larger units. The small generators have sufficient capacity to excite the fields of the twenty generators. A feature of these turbine wheels is, that while similar to other turbines in construction, yet they contain a greater number of buckets than any turbine of the size heretofore built. This was done to prevent any loss of effective area of the buckets in any portion of the revolution.

A distinct feature of this plant is the electric wiring and switchboard, which is situated in the gallery at the southern end of the building. The mains from the dynamos ascend to the gallery where they are connected to the high pressure distributing switchboard, from where they go to the transformer house. On this distributing switchboard are small transformers which transform the voltage from 2400 volts to 110 volts, which voltage is carried to the recording switchboard. This recording switchboard controls and operates and indicates the running of the entire power house and from this point one operator will control all the generators and water wheel governors on the main floor. The operator also has at his command a complete signalling system to the power house floor so that by means of electric lights any signal can be seen throughout the power house. The voltage of the machines is regulated by rheostats, so arranged, that after each dynamo

has arrived at its required voltage, all these rheostats are linked together and run with a small electric motor, so that if the voltage is too high or too low, all the operator has to do is to throw a small switch one way or the other and all the machines either raise or lower their voltage the exact amount. There is no current on this switchboard greater than 110 volts, and as the wiring has all been tested to 800 volts, there is no danger of a breakdown.



Floor Plan of Generating Building.

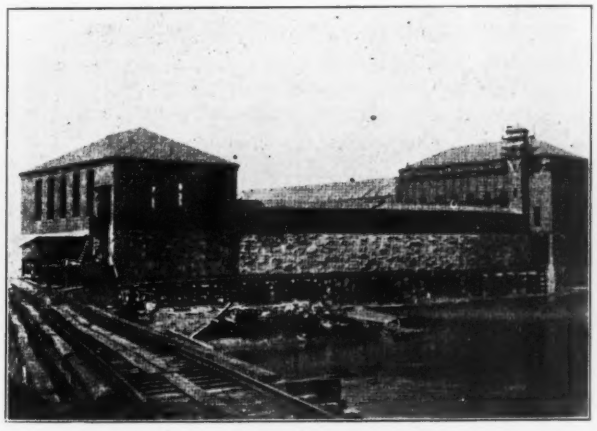
From the distributing switch, twenty-four large lead covered 1,000,000 circular mil cables are led through a covered wire alley, 200 feet long, to the transformer house. The cables are not hung in the ordinary manner but each cable is allowed to rest upon its own wide wooden shelf.

In the transformer house, or step-up station, a building 56 feet wide and 77 feet high, is situated twelve 1400 K. W. step-up transformers with all the necessary lightning arresters, switches and indicating devices for controlling the apparatus therein installed. These transformers are of the Stanley type, filled with oil and raise the voltage from 2400 to 24,000, at which voltage it is carried to the city of York, eleven miles distant upon three small hard drawn copper wires. As it is very important that this transmission line should always be in service, there is another distinct and separate line running to York, so that in case of breakdown or any emergency, one line will always be available.

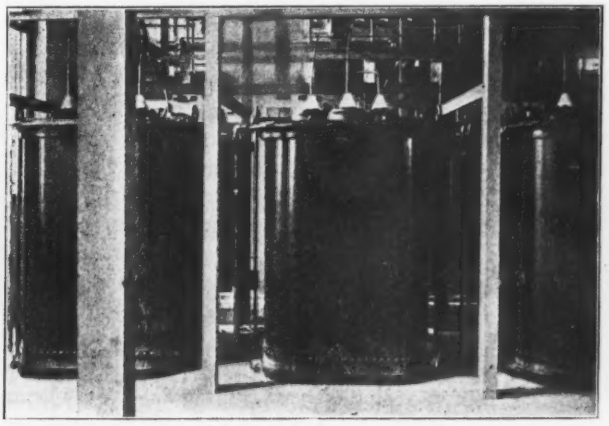
The city of York will be the first city to reap the benefit of this electrical power, but later Harrisburg, Lancaster, Columbia, Steelton and other cities and towns in the neighborhood will be supplied with the electric current for lighting and power purposes.

At the York sub-station, the current is conducted at the entrance of the building through high tension oil breaking switches and through line distributing bus-bars. There it is conducted to lightning arresters and thence to transformer busses and then to six transformers of 800 K. W. capacity each, where it is transformed from 24,000 to 2400 volts for distribution through the city. The distributing switchboard is divided in 5 feeder panels, two panels giving the total output of the sub-station and one panel used for lighting the building. Each feeder is equipped with two three pole oil circuit breaker switches and each panel is also equipped with all the necessary voltmeters, ammeters and wattmeters. From the switchboard current is conducted through lightning arrester banks to the main distributing lines. The transformers, both in the sub-station and the transformer house are of the oil insulation, water cooled type.

When the ice and water receded in the river, an expert examination of the damage done, was made by a number of engineers and it was found that the entire superstructure of the generator building, built of brick, was swept away. The granite retaining wall and the foundations of the power house, wheel pits and all other foundations were very slightly injured. The hydraulic machinery is intact and in place, and was not injured. The electric machinery was damaged by the water but



End view of Power House, showing Transformer House and Wire Alley.



Oil water-cool Transformers in the Transformer House and York Sub-station

the principal damage done to the plant was caused by the destruction of the brick building enclosing this machinery. The most expensive part of the system that was destroyed is the switchboard, which occupied the second story of the southern part of the building. This cost about $30,000 to build and it is doubtful whether any of this can be saved.

It is the opinion of the experts that had the headworks of the plant been entirely completed, this enormous destruction would probably not have happened, as the brick building was not designed to stand the force of the flood and was built many feet above the highest recorded water line. As nearly as can be ascertained at this time, the amount necessary to replace and repair the plant will be about $75,000, and that when completed, it will preclude the possibility of the repetition of damage of this character. It has given the engineers practical demonstration of the destructive force of ice which they could have obtained in no other way, so that when the power plant is rebuilt and finished in accordance with the original plans, it will be made impregnable and will stand any test of this kind to which it may be subjected in the future.

Operating Condensers.

By Albert R. Emmonds.

Many engineers who first take charge of a condensing engine do so with fear and trembling. There seems to be so much mystery about air-pumps, vacuum, injection water, etc., and they are so much afraid of getting into a scrape; for to one who is inexperienced there is a good chance for trouble. I would like to state a few points and tricks about this important branch of the business.

A large proportion of condensers used in stationary work are jet, that is, the cooling water comes into direct contact with the exhaust steam from the engine. No circulating pump is necessary, but an air-pump is, except in the case of a gravity condenser. In connecting up to the engine, it is customary to provide for an automatic atmospheric exhaust, which will open in case the vacuum is lost, and also a valve to be operated by hand. There is also, as a general rule, an automatic float to prevent too much water from accumulating in the condenser. In starting the main engine it is advisable to do so with the exhaust open to the atmosphere, afterward changing over. After the main engine is in motion on the atmosphere, start the air-pump, then open the main injection; now open up gradually on the the exhaust from engine to condenser; at the same time closing down on the atmospheric an equal amount; keep this up until all the exhaust is going into the condenser. In case of failure the automatic valve will relieve the pressure, and then the operation must be repeated. Be sure and have enough injction water going in, but not too much. There should be an automatic float to keep the water from getting too high in the condenser, as previously stated. After shifting over to the condenser, pinch down on the injection water until the vacuum begins to drop, and then open a little, which will be just right. In stopping the engine it is better to change over on to the atmosphere first, not forgetting to shut the exhaust valve from engine to condenser.

We will now consider a case where there is no atmospheric exhaust, and no float to keep the condenser from being flooded. Extreme care will be necessary to prevent an accident. Start the air-pump at a good clip, and after a vacuum has been obtained, admit the injection water. Then start the engine slowly. Be careful that there is not too much injection going in. Bring the engine carefully up to speed, watching the vacuum gauge. Close up the injection until the vacuum begins to drop a little, and then open slightly, as previously stated. Be sure the air-pump is going at a good rate. In shutting down still greater care is necessary. Proceed as follows: Slow the engine down, but don't close the throttle entirely. Then shut down on the injection water until the vacuum falls some; slow the engine down a little more, till throttle is nearly shut. Then shut injection off solid, and after the engine has made a revolution or two, shut the throttle tight. Lastly, stop the air-pump. When starting the engine, if it is necessary to stop for a moment to adjust something, be sure and shut off the injection water and allow the air-pump to make a few strokes afterward, before closing the main throttle. The reason for all this precaution is, that a dose of water is extremely liable to come over from the condenser.

Examiners of engineers are always very thorough on this point as to just how an accident can occur. The correct explanation is this: Suppose that on shutting down, there is some water in the condenser, and just previous to stopping, the vacuum falls off considerably. With the main throttle shut, as the piston comes away from the head, an excellent vacuum is formed in the cylinder, which will be better than that in the condenser. Next, the exhaust valve opens, and into the cylinder the water will rush; the piston will then start to push the water out again, until the exhaust valve shuts for compression, leaving some water in the cylinder. The momentum of the engine jams this between the head and piston, causing a wreck. This should always be borne in mind in running a jet condenser.

In case the air-pump is connected to the main engine, starting and stopping becomes a little more difficult. Water will have to be forced into the condenser at first, until a vacuum is obtained. This can be done by a pump, or, by having a tank placed above, so that the water will go in by gravity. As soon as things get to working properly, the water will flow in of itself.

A surface condenser is much safer to manage. It is used where there is a scarcity of good feed water for the boilers, but plenty of other water for cooling purposes. The condensed steam from the engine can be used over again, as the water does not mingle with it, as in a jet type.

In starting up, simply get the circulating and air-pumps working first. If the air-pump is connected to the main engine it will be necessary to open the condenser drain in warming up, previous to getting in motion.

On a good many English tramp steamships, both air and circulating pumps are direct connected, but one of the donkey pumps is arranged to act as a circulator for warming up.

It requires some attention to keep a surface condenser tight, for there are so many little tubes to leak. There are several ways in which a leaky tube makes itself manifest. If it is of any importance, so much salt water will mix with the fresh, as to increase the volume pumped into the boiler, thus requiring less extra make up feed. Sometimes it will be such a bad leak that the water will rise in the boilers. So much salt water, mixing with the fresh is liable to make the boilers foam, especially if there is insufficient steam space and the fires forced very hard.

A leak may also be detected by tasting the water in the hotwell, and still another is with nitrate of silver. Take a cupful of water from the hotwell and put into it a few drops of the nitrate of silver. If there is the least particle of salt present all the water in the glass will become clouded. This is a very delicate test and will show the least trace.

To get at the tubes, it is of course necessary to remove the condenser heads. Then fill up the exhaust side with water by running a hose into it; the water will run out of any tubes which leak. If there are not too many defective it is best to plug each end, and after quite a number have accumulated, substitute new ones. In order to plug them at both ends, it will be necessary to remove both heads.

Sometimes a surface condenser will give trouble owing to the tubes becoming coated with oil and scale, causing the vacuum to be lowered. A good remedy for this consists in putting a quantity of strong caustic potash into the exhaust side, and then filling up with hot water, allowing it to cook for a number of hours. Then drain it off thoroughly and flush out with clean water. On starting the condenser again, don't let the condensed water get into the boilers until satisfied that it is perfectly clear.

I was once employed on a steamship where the engineers were not careful about this, and we hadn't fairly got started on a trip, when the boilers began to prime fearfully, and the engines to knock in a hair-raising fashion. We had to nearly stop the ship for a few minutes, and surface and bottom blow the boilers very liberally before the trouble was corrected.

THE REGULATION OF STEAM ENGINES.

Method of Speed Control. Cut-off and Throttling Engines.

PART III.

Among the shaft governors previously described, the Straight-line, Ball, Armington and Sims and Buckeye governors belong to the centrifugal type, while the Fitchburg governor belongs to that class of governors which combines the centrifugal and inertia feature. In this latter governor, the large weights are thrown outward by the centrifugal force and their movement is restrained by coiled springs, the smaller weights being affected in a tangential direction by their own inertia. The engine is governed at any stated speed by the large weights but any small fluctuation in speed affects the inertia weights, which in turn operate the valve, causing the engine almost instantaneously to resume its normal speed.

Another governor, which is representative of the centrifugal form of governor is shown in Fig. 20. It is used in the Westinghouse standard engine and the figure represents the governor at rest. The two weights B B are pivoted so as to be capable of movement in radial lines outward from the shaft. They are held in equilibrium by the heavy springs D D, which tend to hold them up against the shaft S. As the engine increases in speed the weights move outward due to centrifugal force. This motion of the weights move the links E E and F. These links shift the position of the eccentric C, the arm of which is pivoted at *d*, producing the required motion of the valve. As the eccentric is drawn across the shaft to the left, its center is brought nearer to and farther around the center of the shaft, thereby decreasing the valve travel and at the same time increasing the angular advance. The effect of this increase in angular advance with the shorter valve travel gives an earlier cut-off without altering the point of admission.

The governor is enclosed in a case which is filled with oil, the eccentric alone being outside of the governor case, being carried on a shaft running through a sleeve, and bearing against stops when at full throw. The face of the eccentric is a segment of a sphere, to which the eccentric strap is scraped. In the compound engine of this type, the cylinders are single acting and the functions of admission, cut-off, exhaust and compression on both the high and low pressure cylinders are effected by a single piston valve, connected to this eccentric.

The Noye governor shown in Fig. 21 is very much similar to the Straight-line governor, the chief difference being in the shape of the weight arm and in the method of connecting the leaf spring to the governor ball. In the Straight-line governor, as described in another issue, the end of the spring is connected with the weight by a thin steel band or metal strap while in the Noye governor a straight rod R is used for this purpose. This governor is equipped with a dash pot to steady its action and avoid pumping.

A well known governor which depends upon the centrifugal action to operate its valves is the McIntosh and Seymour

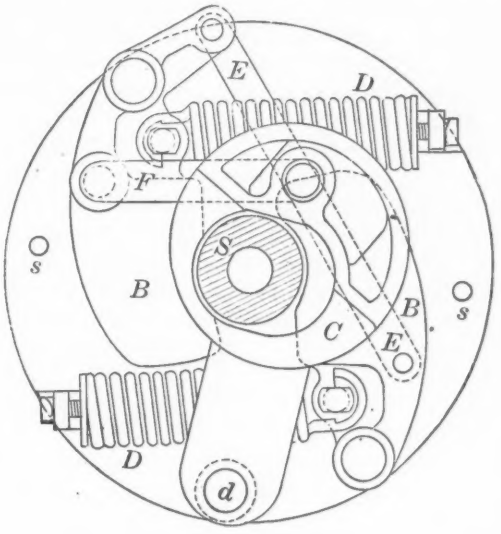


Fig. 20.

governor. The accompanying illustration, Fig. 22, represents one of these governors. In this figure the centrifugal weights W W have moved into their extreme outer position and at the same time have pulled ahead the eccentric, to which they are connected by links and which is free to revolve on the shaft, sufficiently to cut off the steam entirely from entering the cylinder. This condition is approached when the engine is running and the load is thrown off. The centrifugal force of each weight is opposed in a direct manner by a plate spring through a hardened steel pin with a ball-and-socket bearing at the end of the spring and at the center of gravity of the weight, so that there is no friction or pressure due to this force upon the pin upon which the weight swings. This permits the use of a very heavy weight, having great centrifugal force and making the governor powerful. The pins are made of tool steel, hardened and ground, turning in bushes of phosphor bronze. The tension pins between springs and centrifugal weights are arranged to telescope, in order that they can be

adjusted to secure proper sensitiveness, for by lengthening or shortening these pins the governor can be made to regulate with more or less closeness. As will be seen dash-pots are provided, which give stability to the governor, so that it can be adjusted without tendency to race under a fluctuating load.

The speed at which the engine runs can be raised or lowered by reducing or increasing the weight of the pieces provided for that purpose in holes in the centrifugal weights. As the exhaust valves of these engines are driven from fixed eccentrics, the governor only regulates the cut-off valves by changing the position of the eccentric.

A peculiar type of governor employed in the Rice automatic engine is shown in Fig. 23, and is known as the Rice governor. In this governor the weights, W W, are linked to the rocker arm, A, in such a manner that the outward movement of the weights throws the right-hand end of the arm downward and the left-hand end up, rotating the spindle to which the arm is keyed. The influence of centrifugal force is opposed by a double leaf spring, S. The shaft to which the rocker arm, A, is keyed passes through the center of the crank pin, the governor being housed on the rear side of the crank disc. The rocker shaft carries on its outer end a crank, which in turn carries a hollow wrist-pin to which the valve rod is attached. The movement of the weights rocks the shaft in one direction or the other, altering the distance of the valve rod wrist pin from the center of the engine shaft, and thus changes the throw of the valve.

Before continuing the description of the numerous forms of modern shaft governors, it may be well to consider some of the requirements that are demanded of it. While it is a very simple appearing mechanism, it is by no means easy to weigh correctly the many important considerations which present themselves to the designer. The development of electric lighting and power plants has called for a class of engines in which

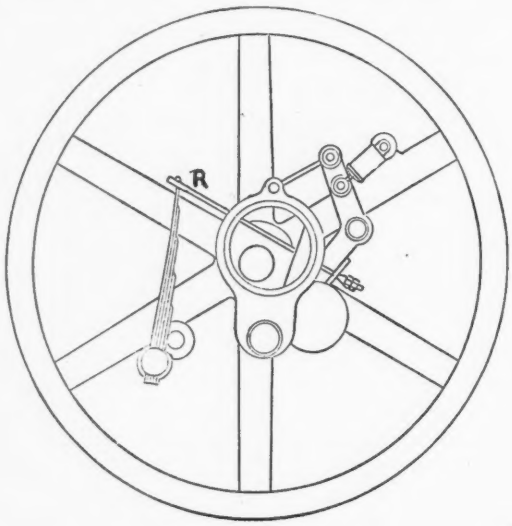


Fig. 21.

nearly perfect regulation is demanded. In most cases, an extreme fluctuation of speed of 2 per cent, is considered high, though the load may vary from zero to the maximum capacity of the engine, and all modern governors come within the limits of this specification. The governor must also regulate the pressure from stroke to stroke. The variation in this pressure is sometimes very great even though the average variation for one minute is within the limits named. In most engines, this stroke to stroke variation is quite as important as the change of speed for one minute. Its effect is to bring the point of cut-off far too early in one stroke and as much too late in the next, these fluctuations taking place each time there is a

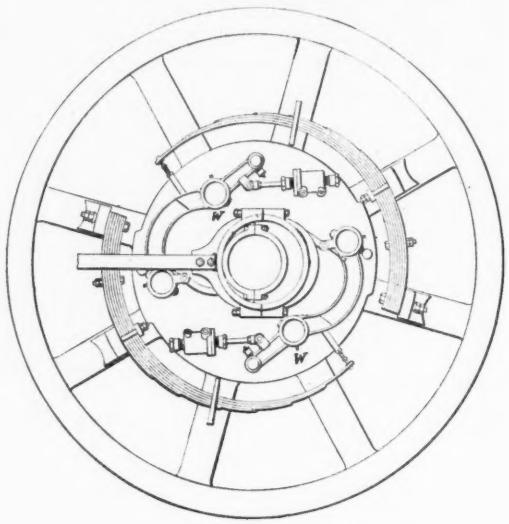


Fig. 22.

change of load, with an effect which is not conducive to economy. Take for example, an engine supplying power for incandescent lighting. Unless the engine is so small that an ordinary change in the load will give a considerable change in the point of cut-off, it does not matter so much if there is a considerable change in speed between friction load and full load, because in practice, this extreme change seldom occurs. The important point is that any moderate change in the load shall cause practically no variation in speed, and that there shall be absolutely no "racing" or violent fluctuations of the governor, thus preventing those sudden changes in voltage which in lighting purposes is so disagreeable to the eye and so destructive to the life of the lamp.

By good regulation, then, is meant, that while the average change in speed shall not be more than one or two per cent., the instantaneous variations during a sudden change of load shall be a minimum and the variation between full load and friction shall not be more than 1½ or 2 per cent.

In order to show a few of the problems which present themselves in the endeavor to secure good regulation see Fig. 24. Let O represent the point of attachment of the weight lever to the fly wheel, D the outer and C the inner positions of the center of gravity of the governor ball, B and A corresponding points of the spring conections to the lever arm, S the center of the shaft, and K the point at which the spring is fastened to the fly wheel. This spring must have initial tension when the engine is standing and the governor balls resting against the stop at the inner position. Because of this initial tension, the balls will remain in this position when the engine is started up, until the normal speed of the engine is reached thus giving maximum cut-off. Any further increase in speed will, due to the centrifugal moment, cause the balls to leave the inner stop and take up a new position, where the spring and centrifugal

moment again balance and thus shift the eccentric center to give an earlier cut-off.

If, throughout the entire range from C to D, the centrifugal moment exactly balances the spring moment for the normal speed of the engine, it is an isochronous governor. Any increase in speed will cause the ball to fly to the extreme outer position and any decrease will cause it to fly to the extreme inner position. Not only would changes of speed cause this "racing" between extreme positions, but any other force such as the drag of the valve, friction or gravity action would cause it. This "racing" between extreme limits causes cut-off to change correspondingly even though there be but little change would then be too weak for all points outside of mid position and too strong for all points nearer the shaft. Any increase in speed would then cause the ball to fly out against the outer force at some speed above the normal; toward C it will be balanced at a lower speed. With this combination it requires either some disturbing force or a change of speed to shift the ball. This is then a stable governor and the greater the disturbing forces, the farther the governor departs from good regulation, so that it is of importance that light balanced valves be used, gravity action eliminated and governor friction reduced to a minimum.

Suppose for comparison that a weaker spring be used instead of a stronger one; and give it sufficient initial tension to balance centrifugal force in the mid position. The governor To accomplish this, a stronger spring is selected which has less initial tension, such that at about mid position of the ball, the spring and centrifugal moments be equal for the normal speed of the engine. For any point nearer D, the spring would have the advantage and can only be balanced by the centrifugal of load on the engine and evidently, as before mentioned, this is a very unstable and undesirable governor.

In order to obtain stability, it is necessary that a slight increase of speed be allowed between the inner and outer stops.

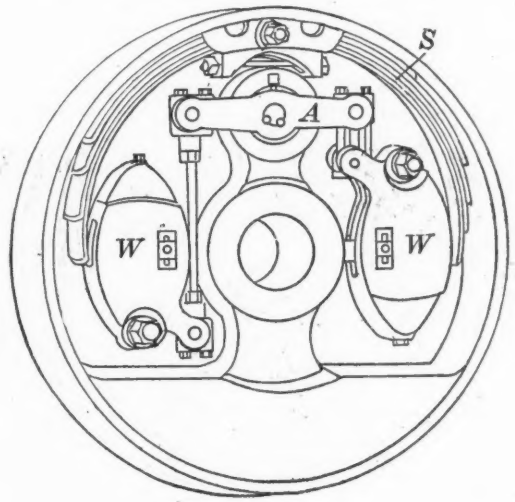


Fig. 23.

stop, where the centrifugal force would have a decided advantage. Here it would remain until the speed due to too early cut-off decreased below the normal, thus lessening the centrifugal force until its moment and that of the spring balanced; and further decrease of speed would tend to cause the ball to fly to the inner extreme, where the spring would have the decided advantage and hold the ball there until the speed had increased considerably beyond the normal, when it would again tend to fly to the outer extreme. This would constitute a very unstable form of governor, and would intermittently tend to throw the cut-off clear from the minimum to the maximum,

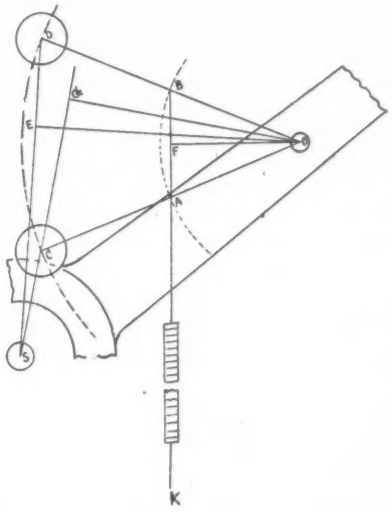


Fig. 24.

then back again to the minimum and so on, causing a very considerable change of speed.

From the above, then, it can be seen that when a governor spring is used which will just balance the centrifugal force for all positions at normal speed, an isochronous arrangement is secured, but it gives a governor which is unstable and sure to race, due to such outside forces as valve drag, friction, change of load or gravity action. By using a weaker spring, the governor will be still more unstable and sure to race, while the fluctuations of speed will be considerable. By using a stronger spring than that required for perfect isochronism, the more stable will the governor be and the greater the increase of speed between light and full load.

Laminations in Boiler Plates.

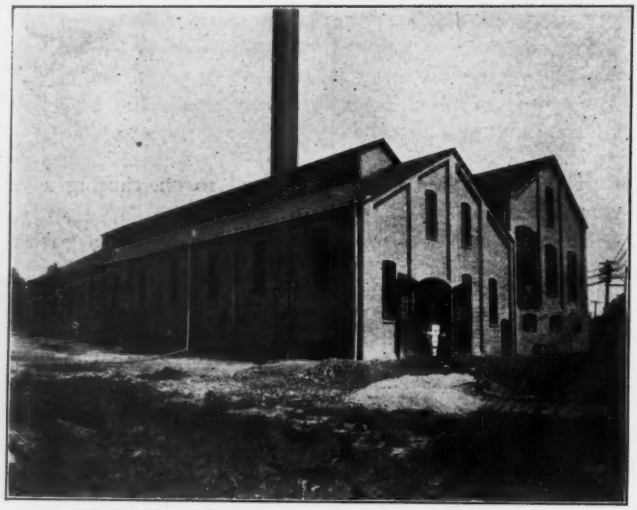
When boiler plates are not solid in one piece but are in layers like the leaf of a book, they are said to be laminated. For many purposes, the fact of a plate being laminated is of no great consequence; but the chief evil is that if any portion of a boiler plate is exposed to the action of the fire, and that portion is laminated, say in two layers, the layer next to the fire will expand with the heat and form a blister which will crack very easily; therefore the place where this occurs will be the thickness of the blister thinner than before, and consequently weaker; and if this thinness extends over a large area there is, of course, danger of its bursting. The way to sound a plate is as follows: Hammer the plate all over with a light hammer. If the plate is of good solid iron it will sound clear, and the hammer will fall heavy on it; but if it has a tendency to blister, it will give a dull sound, and the hammer will rebound. Both sides of the plate should be tested in this manner. Sometimes a plate will appear quite sound on one side, but will be found defective on the other.

A SUBURBAN TROLLEY POWER HOUSE.

A Condensing Plant Situated on the Banks of the Perkiomen at Collegeville, Pa.

As the number of trolley lines surrounding every city have increased so rapidly and as these lines are extending their iron rails far into the country, it has caused numerous power houses to spring up along these lines for the more economical distribution of power. One of these power houses is illustrated in the accompanying article. It is situated at Collegeville, in the eastern part of Pennsylvania, about one-half way between Norristown and Sanatoga, the two towns being the extremities of the line which the power house feed. Its location along the banks of the Perkiomen and near the railroad affords it excellent opportunity to receive the necessary food required by the power plant.

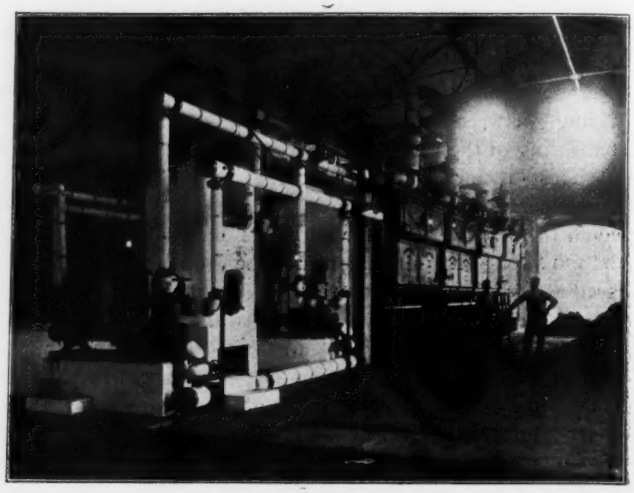
The power house is a large brick building 100 feet wide by 150 feet long and consists of two distinct sections, one for the engines and one for the boilers, the engine room being considerably the higher. Both parts of the buildings have high peaked roofs. The walls of the engine room are



Exterior of Power House.

strengthened by latticed columns, which support girders carrying the track for the travelling crane which spans the entire room. The crane has a capacity of 25 tons and was built by the Reading Crane and Iron Works. The floor of the engine room is of concrete resting upon corrugated iron arches supported from I beams. The roofs are made of steel trusses covered with slate so that both sections of the power house are fire-proof.

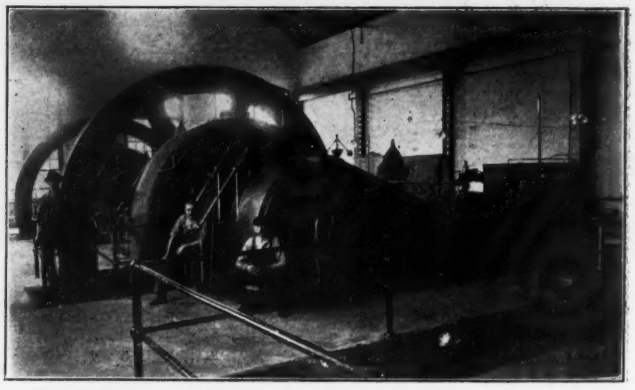
In the boiler room is a battery of four 300 horse-power Heine boilers, placed in one row on the side nearest the engine room. The floor of the engine room is considerably higher than that of the boiler room, so that the steam piping is carried from the tops of the boilers underneath the engine room floor to the cylinders. The boilers are fed by hand with anthracite buckwheat coal, the flue gases going out an iron stack, self supporting, 8 feet in diameter and 125 feet high. A Paterson Damper Regulator is used to regulate the draft. As the plant runs condensing, the feed water is pumped from the condenser to an overhead tank by a Smith-Vaile duplex pump, which is so connected that it can pump water from the creek in case the engines are run non-condensing. The feed water flows from the tank by gravity to a Warren-Webster feed-water heater and purifier from which it is fed to the boilers by two Smith-Vaile pumps 7-in. x 4-in x 10-in., this type of pump having two steam cylinders and four water cylinders. The condensers are of



Interior of Boiler Room.

the usual jet condensing type, the pumps which pump the condensing water are of the fly wheel type, the water and steam cylinders of which run tandem. The condensing plant was built by the Pennsylvania Iron Works.

The engine room at the present time contains two 750 horse-power cross compound condensing engines built by the Pennsylvania Iron Works and the plant when finished will contain five of these units. The engines are directly connected to 500 K. W. generators and run at a normal speed of 100 revolutions per minute. The fly wheels weighing 40 tons are made in eight pieces linked together and are 18 feet in diameter. There is a spring attachment connected to the flywheels of the engines to prevent the engines from running away. It is set so that when the engine acquires a speed of about 115 revolutions, or about 15 more turns than the average, a weight will fly out due to the increased centrifugal force and move a lever attached to the engine bed. This lever operated a weight of about 500



One of the 750 H. P. Cross Compound Condensing Engines.

pounds which weight is released when this lever is moved. The weight, being released, drops down and closes a valve in the main steam pipe, thus preventing any runaways.

The engines are oiled automatically by a gravity system. A tank whose capacity is about 7 barrels is located about 25

feet above the engines and filled with oil. The oil runs down through all the bearings by means of gravity into several filters, from which it is pumped back into the tank by a 2-in. x 1⅛-in. x 2¾-in. Worthington duplex pump. The main bearings of the engine are also cast hollow so that they can be water jacketed if necessary.

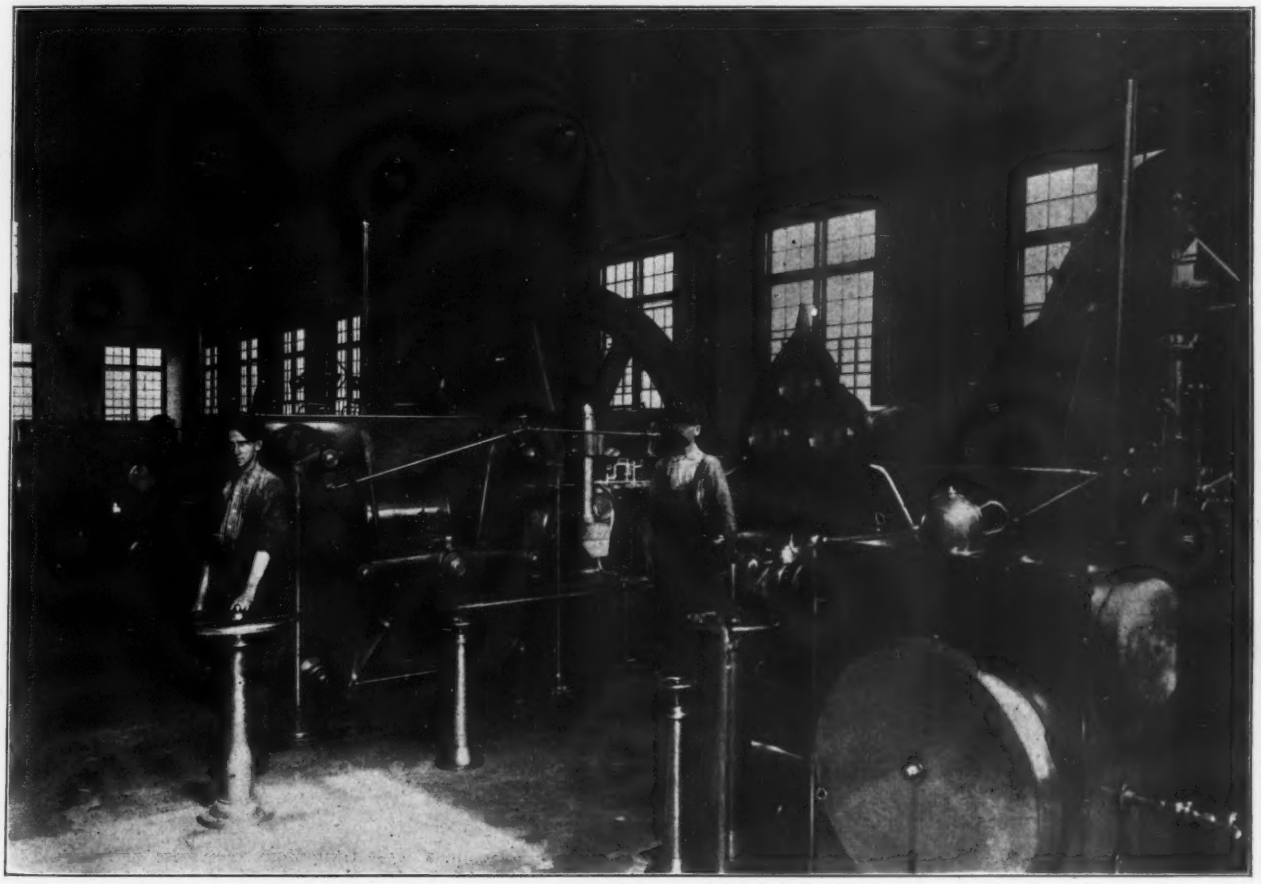
The generators are of the 10 pole Westinghouse type, having a capacity of 500 K. W. The average voltage is 550 and the full load current is 910 amperes. They supply the current to the trolley lines between Norristown and Sanatoga, a distance of 15 miles. Nearly all the route of the trolley line is laid out over the country roads and some very steep grades are encountered so that the generators are frequently required to furnish a heavy overload for short intervals. One of the steepest grades is 13 per cent. which fortunately is near the station.

Sanatoga end. There are three 500,000 circular mill cables connected to the ground return.

There is an interesting attachment on the engines for taking indicator cards and consists of a bar about 2 inches in diameter with a helical slot cut in it, so proportioned that when the engine travels the full length of stroke, the bar revolves enough to give the indicator the required motion. The bar runs in two bearings and is parallel to the piston rod. A pin attached to the cross head engages with the slot and can be engaged or disengaged at will, the indicator string being connected to a pulley on the end of the bar.

Babbitting Journals.

When about to babbitt a journal, wrap one thickness of common writing-paper smoothly around the bearing, fastening it in place with twine wound around the shaft in a regular spiral. The paper keeps the babbitt from getting chilled by the journal. It will also have a fine surface and will also fit just right without scraping. The twine leaves grooves for the oil. Before pouring the metal through the oil-hole, make sure the journal is level and in central position. By means of two pasteboard rings fitting the journal, the ends of the box are closed by using putty or soft clay. A high funnel of clay is made around the oil hole to facilitate the pouring in of the babbitt and to increase the pressure, so as to have the babbitt fit the box perfectly.



Interior of Engine Room.

The marble switchboard which stands at the center of the power house is 7½ feet high by 11 feet long and is arranged to be enlarged as the station is enlarged. It consists of two main panels, one station panel and five circuit panels. The instruments consist of 7 Westinghouse ammeters, two voltmeters, one station ammeter, one station voltmeter, one differential voltmeter and one Thompson recording wattmeter, besides the usual switches and circuit breakers. The five different sections of the line are fed with 500,000 circular mill cables. Two of these connected in parallel, supply the Norristown circuit, and one of these in parallel with a No. 0000 wire run to the

Changes and Improvements.

By W. H. Wakeman.

Some time ago I needed disks for 6-inch valves, and ordered them of a local dealer. When an effort was made to use one of them, it would not go on. The outside diameter was correct, but the disk was made wider, hence the inside diameter was less. Engineers know that as a rule, the time available for making changes on the main stop valves of boilers is limited, for if one of them requires repairs the boiler must be emptied and cooled off. If it is one of a battery, the whole of them will have to be shut off in order to remove pressure from the main steam pipe.

It is rather exasperating, to say the least that will answer the purpose, under such conditions to find that a large disk will not go into place, for it is not a short job to file one until it fits. Somebody had evidently come to the conclusion that the standard disk was not wide enough to do good service, hence had made some of them wider, but from my point of view the change was not an improvement.

The standard width gave a full bearing on the seat with some to spare, hence it would be no better if made 2 inches wide, while a departure from the standard size is sure to make trouble. Fortunately I had one of standard size on hand, left over from a former lot, and it was used to repair the valve.

Gate valves seem to be in evidence in our plants more than formerly. What improvement is claimed for this change? The gate valve has its place, and it is all right in that place, but this fact does not prove that it should be used everywhere. The globe valve has a crooked pasage through it, which causes much friction under certain conditions, but where only steam passes through it, this crooked passage is not a great objection, but of course it is where cold water flows through the pipe to which it is attached.

The gate valve is objectionable because it takes too long to open and close it, and when it is desired to only open it partially there is no practical way of determining when it actually begins to open. One revolution of the wheel may open it slightly or it may not, according to the design of valve, and the only way to tell definitely is to watch the gate as it slides backward, and count the revolutions given to the wheel. As this is seldom practical the engineer must guess at its position. With a globe valve the case it different, as it can be shut tight, and when the wheel is turned backward enough to release it, the engineer knows that it has begun to open, and he can then give it a large or small opening according to conditions.

It is claimed that the gate valve is stronger than the globe valve, because the gate closes the opening without depending on the threaded valve stem to resist the pressure. This is true, but it is not always a valuable consideration. For illustration of this point take a radiator or bank of pipes forming part of a heating system, using steam at 5 pounds pressure. Is there any need of putting gate valves on here? I have globe valves that have been in use for nearly ten years that are tighter than some of my gate valves which have been used less than one year. Cause for the difference is found in the fact that when one of the globe valves leak, the old disk is taken out and a new one put in, but this cannot be done with the gate valves as the gate is made wholly of brass.

Gate valves are sometimes made with removable disks, but they are not a complete success as it is difficult or impossible to keep them tight. With the all brass gate valve now commonly used, all that the engineer can do is to continue its use until it leaks so badly that it becomes an intolerable nuisance, then have it taken out and a globe valve put in its place, but by this time enough steam has been wasted to pay for several valves.

Some time ago I saw a pair of boilers on which a 5-inch pipe extended from the steam space of one to the same point on the other. In the middle of it there was a gate valve of inferior design, that was not tight when new, and it grew worse the longer it was used. So long as both boilers were in use, the condition of this valve made no difference to anybody, for if there had been no valve there at all, the steam would have circulated through this pipe and kept the pressure equal, which was the only object of its use, but when the engineer wished to lay off one boiler, to clean it, or to accommodate the boiler inspector, steam and hot water always dripped into it, making it unpleasant for all concerned, and causing rust on the tubes at this point.

The gate valve afforded a straight passage for steam, but a globe valve with a removable disk would have answered every purpose and it could be kept tight without expensive repairs.

It is true that the pressure does not act directly on the threaded valve stem, in the case of a gate valve, but a globe valve so seldom fails at this point that the claim made is practically out of the question. These conditions and more that I might mention, show that he change from globe to gate valves is not always an improvement.

One of the latest changes made in steam pipes is the substitution of steel for iron in constructing this important part of a steam plant. Now it is all right to sit in an office or a laboratory and calculate the increased strength due to the use of steel, also to think about its freedom from blisters, and how much lighter it is than iron pipe, but when a man must work in proximity to this pipe day after day, and after a time a length of it snaps in two like a pipe stem, what is he to think of the change, provided he is able to think at all after the accident? Is it at all surprising if he prefers the tough wrought iron pipe that he has used for years without failure? This so-called improvement is not always appreciated as much as some of our designing engineers would like to have it, but it is probably taken at its true value.

I sometimes wish that pipe was universally bought and sold by the pound instead of by the foot, because in that case the temptation to make it as thin (and as weak) as possible and still have it hold together under favorable circumstances, would be removed. The steam user would not care to have it made heavier than necessary, but extra cost along this line would then mean extra strength, and such a fault is a good one to find.

A few days ago I examined a duplex pump and receiver used to collect hot water (resulting from the condensation of steam in heating a building) and put it into the boilers again. The throttle valve for the pump is connected to the steam pipe, where it is accessible for inspection and repairs. The pump lubricator is located in front of this valve so that all cylinder oil goes through it on its way to the cylinders. It is rather difficult to keep such a valve absolutely steam, water, and air tight, yet leave it in proper shape to work easily. The con-

sequence is that unless a drip pan is provided, some of the oil and water find their way to the floor.

This is an old fashioned apparatus, still it operates perfectly, with the exception noted which is scarcely worth mentioning. In order to overcome this, a comparatively new device has been brought out, in which the balanced valve is located inside of the receiver. This prevents all drip of oil on the floor, but where does it go now?

If the lubricator is located in front of this valve, as it should be, cylinder oil drops into the hot water and is pumped into the boilers where it is not wanted, consequently it must be put nearer the pump, leaving the balanced valve to use dry steam, therefore it "sticks" occasionally and fails to control the speed of pump in a proper manner. Only kerosene can be run through it to overcome this fault.

If this valve needs adjusting or repairs, there is one way to do it, and that is to shut steam off from the building, cool off the receiver and take out the valve. Engineers will appreciate the difficulty or the impossibility of such a course, during cold weather. This valve is not even supplied with a lever by which to move it in case it does not work freely, and but few of them are found that are always in first class order. This statement is not meant to convey the idea that these valves are not as good as the average steam appliance, for they are; but we have nothing along this line that never needs attention.

This is another case where a change is an improvement in one respect, but proves detrimental in another and more important point.

There are other cases that might be cited to illustrate this point, but enough have been presented to show that while our machinery of various kinds is not perfect, some of the efforts made to improve it do not accomplish all that might be desired, while others are positively detrimental when all things are considered.

Results of Tests Made on Gas Engine Pumps.

The pumps in the Philadelphia High-pressure Service Station, which were described in the January issue, were recently tested for a twenty-four hour run. In that period, the water pressure developed fluctuated but slightly, the average pressure being 303.6 pounds per square inch. The water was drawn from the Delaware river and discharged into the overflow, the pressure being regulated by the automatic pressure valve.

The engine consumed 20.54 cubic feet of gas per horse-power per hour. For the twenty-four hours 117,455 cubic feet of gas was consumed, according to the meter, which, at the rate of one dollar per thousand cubic feet, cost $117.45. The engine during the test generated 238 horse-power, considerably less than its rated horse-power.

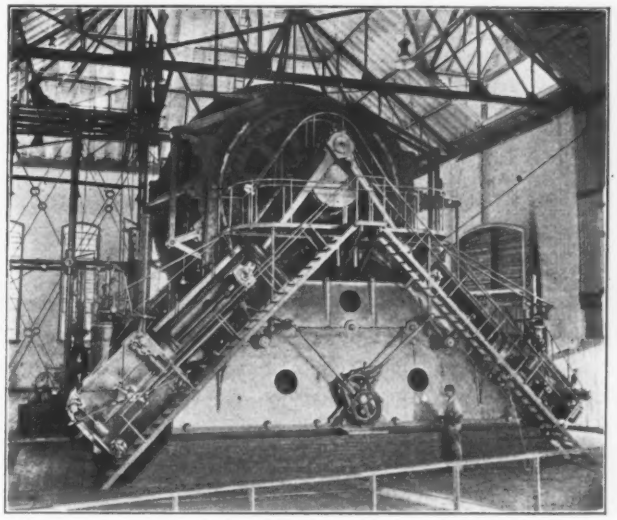
These engines are of the 4-cycle pattern, each engine having three vertical cylinders, 18 inches in diameter and 22 inch stroke and are rated at 300 horse-power when running at a normal speed of 200 revolutions per minute. They are directly connected to triplex pumps each cylinder having a diameter of 11.5 inches and a stroke 12 inches. The cylinders of the engine were cooled by water jackets, the temperature of the inlet water being 37 degrees and that at the outlet 80.8 degrees.

The above value of fuel consumption, however, was agreed by all the engineers present, who made the test, that it was very much too high, as the form of meter used was unreliable. The engines were previously tested for efficiency and they then showed a consumption of 12.4 cubic feet per brake horse-power per hour. Based upon this consumption, the cost of an engine horse-power per hour would be, assuming the gas to cost one dollar per thousand cubic feet, $1.24.

While economy is a secondary consideration with everything connected with engines used for fire purposes, yet these figures compare very favorably with other gas engines used for manufacturing purposes, and the success of this system has attracted the attention of many municipalities throughout the country. The big fire in Baltimore, closely followed by Rochester's disaster, has renewed interest in the system and several cities have already planned systems of their own upon lines of this pumping station. There has not been a large fire in Philadelphia since this station has been in operation and one conflagration, which promised big things, was so quickly conquered by the flood of water poured upon it, that it never spread from the place where it originated.

A Large Mine Hoisting Engine.

In the earliest days of steam engineering, when the first engines were introduced in England, they were used principally for pumping water out of the mines. In contrast to these old engines will be noted the four cylinder reversible hoisting engine used by the Tamarack Mining Co., Calumet, Mich.



5000 H. P. Hoisting Engine.

This hoist is the most powerful of any yet constructed in the world. The four cranks on the engine are connected to two crank pins, on each side of the large drum which carries the hoisting rope. They are so arranged that each pair of cranks have an effective turning moment when the others are on their dead point. It is operated and controlled by a man seated on a platform above the engine, who, by means of a system of levers connected to the necessary valves, has the engine at all times under perfect control.

The load on the engine consists of 6000 feet of 1½ inch rope weighing 21,800 pounds, a cage weighing 4200 pounds, two cars weighing 4000 pounds and the amount of rock hoisted 12,000 pounds, making the total weight to be lifted at the start 42,000 pounds. The hoist is designed to lift this total load of 42,000 pounds at a maximum rate of speed of 5000 feet per minute, the total lift of the hoist being 6000 feet.

The Practical Engineer

PUBLISHED ON THE FIRST OF EACH MONTH

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Water Tube Boilers. The recent explosion of a number of water tube boilers has given rise to the discussion of some of the advantages and disadvantages of this type of boiler. The water tube boiler differs from the type of fire tube boiler in that they are so arranged that the water is on the inside instead of the outside of the tubes, these tubes usually forming the greater part of the heating surface. The supposed safety of the water tube boiler depends upon the fact that the main shell is always comparatively small in diameter and that the tubes are only subjected to the intensely concentrated heat of the fire and the parts, in which the danger of rupture lies, are not subjected to the concentrated heat of the fire.

Of the different forms of water tube boilers in use to-day, by far the greater number are of the horizontal type. They differ from each other principally in the details of construction of the headers into which the tubes are expanded, most of them being made up of sectional headers, into which are expanded from two to eight or ten tubes, each header being connected by a separate tube with the main shell. There are other types in which the header, which is really a water leg, is made up of plates of flanged steel, riveted to the main shell. The tubes are expanded into one sheet of the water leg, the opposite sheet being provided with hand holes and plates for access to the interior of the tubes.

The general advantages usually claimed for a water tube boiler are as follows: The portion of the boiler which contains the water is so small in diameter that the material used in the construction can be made comparatively light without impairing the strength. Consequently the heat is transmitted to the water more readily and the danger of burning the iron where it is exposed to the fire is greatly diminished. The tubes contain no riveted joints and consequently no double thicknesses of metal are exposed to the fire. The draft area being larger than in a fire tube boiler gives more time for the absorption of heat of the gases before their exit to the chimney. The gases are more thoroughly mingled in their passage between the staggered tubes and the combustion is therefore the more complete. The gases also impinge against the heating surface perpendicularly, instead of gliding along the tubes horizontally, making the absorption of heat more thorough. The circulation of the water in the boiler is more rapid and as a result, the temperature of every portion of the boiler is practically the same and the tendency to deposit scale is materially lessened.

The water in a water tube boiler is divided in many small bodies so that steam can be raised rapidly. This division of water into small masses avoids destructive explosions, as the circulation is so rapid that it keeps the heating surfaces free from steam bubbles and in this way facilitates a rapid transference of the heat from the gases to the water within the tubes; so that an explosion from overheating is not so likely to happen.

The space occupied by this type of boiler for a given power is much less than in fire tube boilers. The boiler is more accessible for cleaning and repairs; it is less cumbersome and more easily transported; less dust is likely to collect on the tubes with its accompanying loss of heating surface, and so on can its advantages be mentioned.

While many of these advantages have been actually borne out by practical experience, it must also be remembered that many engineers still prefer the fire tube type. Explosions are not an impossibility with either type, but from the standpoint of safety, the water tube boiler is distinctively better. The water tube boiler is a much more expensive apparatus than the fire tube, and this reason alone will cause the latter to be retained in many cases and where the cost of fuel is low, so as to make the economy in its use a secondary consideration, the fire tube type will continue to be widely used.

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Liquid Fuel for Power Purposes. It has often been a matter of surprise to the engineer, that oil has not been more frequently used for fuel under stationary boilers. The ease with which such fuel can be handled and controlled; the freedom which it gives from dirt and smoke and the thermal advantages which it possesses has made it a fascinating subject for engineers, and from a theoretical point of view, it appears, in many instances, as if coal could not compete with it. The principal reasons why its use has not been extensive have been,

aside from any mechanical features that may be involved, that up until a few years ago, the supply has been comparatively limited and the cost of transportation to power plants a considerable distance from the source of supply has been excessive. So far as mere calorific value is concerned, crude oil is about 1.7 times as good as a standard grade of steam coal and in many localities where it can be had by piping from the wells, it is quite capable of being used more economically than coal.

This fact is being proven by the growth of oil burning power plants throughout Texas and California since the recent discovery of the new oil fields. These discoveries have been so extensive that there is good reason to believe that these oil wells will not soon be exhausted and an extensive supply of oil to meet the demands for the future, seems assured. It is this, together with the cheapened cost of transportation, due to newly constructed pipe lines and the high price of coal, which has prevailed in many manufacturing districts in the west, that has caused the use of crude oil to be used more in the past two years than all the other years in its history.

The amount of petroleum produced every year is enormous and if there continues to be an increased demand for power purposes, the law of supply and demand will probably mean a higher price due to this increased consumption. For instance, in 1901 the production of petroleum reached the total of 69,380,214 barrels and sold at an average price of 95.7 cents a barrel, while in 1900, when not so much oil was produced, it sold at $1.19 a barrel. It was this decline in price that brought the oil within the reach of the manufacturer and hence the increased number of consumers. It is often generally stated that oil must sell below a dollar a barrel before it can compete with coal and as soon as the price goes above a dollar, the manufacturers cease to use it on a large scale.

It has been this fluctuation in price, together with the fact that the oil industry is in the hands of the greatest monopoly that was ever organized and the fact that the price of oil in many parts of the country depends upon whatever they choose to make it, that has deterred many manufacturers from using it. Notwithstanding this, the price has been so much lowered that its use is now extensive. The growth of its application in the west can best be examplified by the statements that one railroad alone in California is now burning oil on about 200 of its locomotives and another transcontinental line is using oil on more than 300 of them. It is also stated that stationary practice in Texas and California is also making like progress in the use of the liquid fuel, so that it has now become quite a factor in the engineering world.

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The Steam Turbine. There seems to be a general misunderstanding in reference to the efficiency of a steam turbine as compared with other engines. The theory of the steam engine in no way conflicts with the theory of other heat engines. They all depend upon the same expression for ideal efficiency. This expression for the efficiency is represented by the formula $\frac{T1 - T2}{T1}$ in which T1 is the absolute initial temperature and T2 is the absolute final temperature, expansion being carried out to the final temperature. This formula is not only applicable to the steam turbine and the ordinary forms of reciprocating engines, but also to heat engines of any description. It can therefore be seen that the only way to increase the possible efficiency is to increase the initial temperature or to decrease the final temperature. If, then, the temperature of the steam entering the engine is known as well as the temperature of the exhaust, the maximum efficiency of any engine can be readily calculated and if the efficiency of any engine is said to exceed this amount, running under the stated conditions, there is either a wilful misrepresentation, or a lack of knowledge in the fundamental facts of the science of thermodynamics.

The steam turbine has unfortunately been the victim of some of these wild statements, principally, perhaps, because its horse-power cannot be so readily calculated as in a reciprovance in the progress of steam engineering, its efficiency has cating engine and while the steam turbine represents an adnot been any better than can be obtained in the very best reciprocating engines. While the steam turbine is very valuable for many special uses, it has yet to prove that it can replace the reciprocating engine along ordinary lines and the hue and cry that it is going to replace all other types of engines seems to be rather premature.

As before stated, the above formula represents the ideal efficiency, and all reciprocating engines have a very much less efficiency than this owing to such internal losses as wire drawing, clearance, initial condensation and condensation during expansion, re-evaporation, incomplete expansion and unnecessary back pressure. The loss due to initial condensation is the most serious loss of those mentioned and grows worse as the temperature limits are increased, so that any effort to improve the theoretical conditions are met with a constantly increasing practical difficulty which limits the point to which expansion may be carried with useful effect and in a measure also the height of the initial pressure that may be advantageously employed.

In the steam turbine the parts in contact with the steam are not subjected to any cyclical variations in temperature, but the temperature and pressure at any given part of the machine remains constant. In the turbine, therefore, this most important loss is eliminated, and there is apparently no reason why there should be any practical limit to the initial temperature or the degree of expansion that may be made with good effect. Since the turbine, notwithstanding this great advantage, does not show any more efficiency than the reciprocating type of engine, its internal losses are probably due to friction caused probably by whatever water there is in the steam, as saturated steam even in an ideally perfect engine contains a certain amount of water due to expansion. It has been suggested that by superheating the initial steam, this condensation can be prevented, but tests of large turbines made with superheated steam have not shown remarkable efficiency. A number of tests made on large turbines with steam at 155 pounds pressure, 45 degrees superheat and 27 inches vacuum have shown a not very remarkable consumption of 19.1 pounds of steam per kilowatt per hour.

In comparing the economy of the turbine with that of the reciprocating engine, it must be remembered, as before stated, that there is no such thing as indicated horse-power in a turbine. The most usual and convenient measure of the power is in electrical units. The economy of the reciprocating engine is ordinarily stated in pounds of steam per horse-power per hour, so that care must be taken in comparing the two, to measure the output in the same units.

Some Types of Triple Expansion Engines.

When a triple expansion engine is spoken of, it means that the steam is allowed to expand in the engine in three stages, but it does not necessarily mean that these three expansions are only done in three cylinders. These ex-

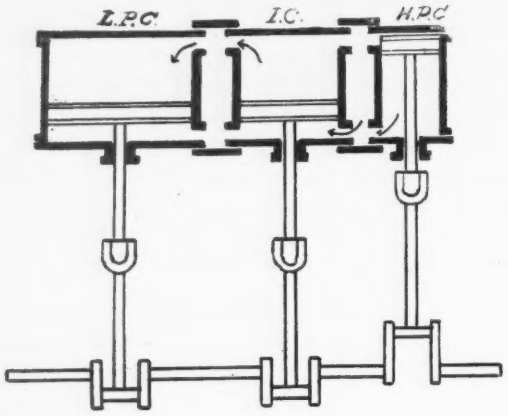


Fig. 1.

pansions may occur in three cylinders or more, depending on the designer, who, for various reasons, may divide each stage of the expansion into two or more cylinders. There can therefore be a great number of combinations of the arrangement of the high, low and intermediate cylinders of this type of engine.

A triple expansion engine also does not necessarily have only three cranks, but can have any number, the most usual arrangement, however, being two, three or four cranks. The accompanying illustrations show some of the usual

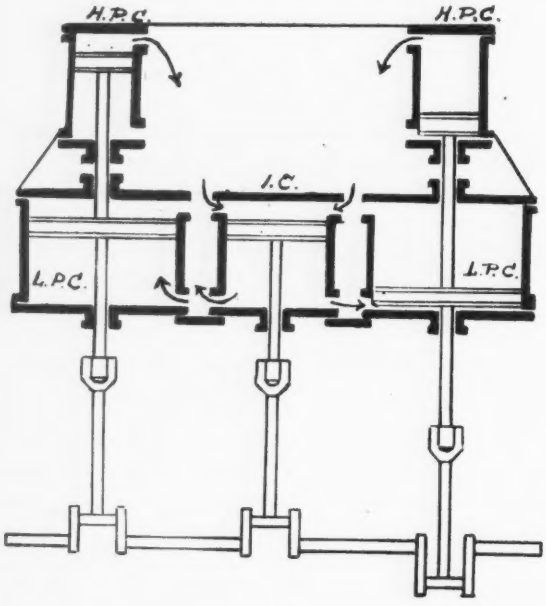


Fig. 2.

forms of triple expansion engines as found in practice. Fig. 1 illustrates a triple expansion engine of the usual type with the intermediate cylinder between the high and low pressure cylinders. The cranks in this case are 120 degrees apart so that two of them are always effective in doing work. This type of engine, when used in stationary practice, requires a comparatively light fly wheel, as the amount of energy that it must store up or give out is not very great, owing to the fact that there are six points in a revolution where the work given out and that absorbed by the fly wheel are equal, compared with only two points of equality, in one revolution, with a single crank engine. The turning effort is also more constant with a three crank arrangement.

The arrangement of having the intermediate cylinder between the high and low pressure cylinder is not always followed as either the high or low pressure cylinder may be between the other two. This latter arrangement is sometimes done to get more receiver space in the pipe which connects the cylinders. A number of engineers favor the sequence, high, low and intermediate, that is, the low pressure cylinder between the high and the intermediate as it gives a better card and the receiver pressure is more uniform.

One of the many arrangements of using more than three cylinders with three cranks is shown in Fig. 2. In this ar-

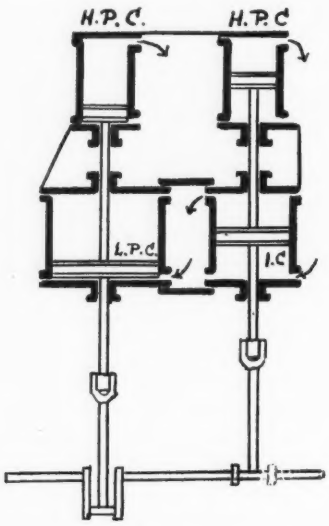


Fig. 3.

rangement there are two high pressure cylinders, one intermediate cylinder and two low pressure cylinders. Steam is admitted into both the high pressure cylinders from the boiler. The exhaust from both high pressure cylinders become the driving steam in the intermediate, the exhaust from the intermediate being divided to drive both the low pressure cylinders. This arrangement is often used in marine practice where there is plenty of head room. By putting the high pressure cylinders above the low, it makes the length of the engine somewhat less as shown in Fig. 1 as the engine is so proportioned that the area of both low pressure cylinders in Fig. 2 would be equivalent to the area of the low in Fig. 1 if the engines were both of the same horse-power.

Fig. 3 represents an arrangement of the cylinders in a triple expansion vertical engine, where it is necessary to make the length of the engine a minimum. In this case there are two cranks and four cylinders, two high, one intermediate and one low. The cranks are at an agle of 90 degrees. Steam is admitted into the two high pressure cylinders and is exhausted into a receiver from which the

intermediate cylinder gets its steam. The intermediate exhausts into a receiver from which the low pressure is fed with steam.

When horizontal engines are of the triple expansion type, they rarely ever have three cranks, but usually have two cranks and three cylinders but are very much less used than the triple expansion vertical type. Fig. 4 represents a triple expansion engine which is sometimes used either as a horizontal or vertical arrangement. The high pressure and intermediate cylinders run tandem and the low runs

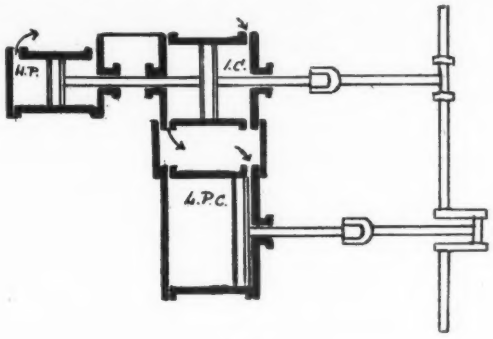


Fig. 4.

separately, the area of the three cylinders usually being so proportioned that the sum of the horse-power of the high and intermediate is made equal to the horse-power of the low, the cranks being set at 90 degrees.

Fig. 5 shows a similar arrangement except that the high and low pressure cylinders run tandem and the intermediate runs on a separate crank, the cranks as before being set at 90 degrees. When engines of the type shown in Fig. 4 and Fig. 5 are used horizontally, the flywheel is usually placed between the cylinders, the pipe leading across from the cylinders being of sufficient volume to act as a receiver.

Triple expansion engines have been used with four cranks, set 90 degrees apart, the cylinders being usually ar-

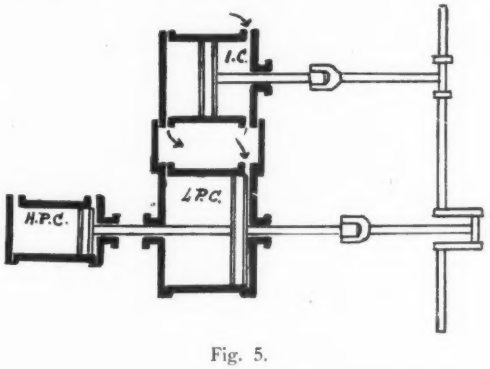


Fig. 5.

ranged in the fore and aft style having one high pressure, one intermediate and two low pressure cylinders, each connected with its own crank. This makes a very expensive construction and is rarely used. In fact it is seldom used even in quadruple expansion engines where they usually get the four expansions by means of cylinders so arranged as to work with three cranks and sometimes two.

In the preceding figures the most usual arrangements of the triple expansion engine cylinders are shown, other arrangements being more generally used in marine practice or in Europe. Some of these arrangements include the four cylinder two crank type, having one high, one intermediate and two low pressure cylinders, the high and low and intermediate and low run tandem. Another arrangement which has been used is of the six cylinder three crank arrangement having one high, two intermediate and three low pressure cylinders, the high and low running tandem between the intermediate and low, which run tandem on each side.

Noon Hour at Powers' Mill.

PART VIII.

By A. Edward Rhodes.

The educational movement is spreading. Dennis surprised us all to-day by informing us "Thot he jist got a letter this mornin from the Korispondince school atellin him thot he got 98 percentage fur his first lesson in rithmetic, an fur him to keep right on an preserve."

Old Dick wanted to know if we did not think these schools do wrong in enrolling as members, such men as Dennis and others who can barely read and write?

"Why boys," says he, "I know a man, an engineer at the Round Rolling Mill, he is fifty years old if he is a day, an as for writing, its a question as to who is the poorest hand at it, him or me. Yet only last week he paid cash for a course in one of these schools."

Donner wetter you fellers makes me dired! I nefer vos a scholard und nefer mooch to school vent bud I dells you's dot der schools dot deach by der writtin sistem is all right in der main. Id is not dere vaults ven one of dere representations represents more as der truth. Dot vas nod der vault mit der school. It vas der feller dot vas hired to work for dem, shust like it vos nod der vault of Mr. Bowers if I vorgets myseluf und blow my boiler oop for my carelessness, ain't dot it Kid?

Yes, Hans, I agree with you. The correspondence school system is all right, and I believe it has come to stay. But say, time is passing away and I know some of you want to know what I found out last night about the flywheel problem we were talking about yesterday noon. The question was: Is it safe to run a cast-iron fly-wheel 18 feet diameter, 22 inches face, 10 inches thickness of rim, 100 revolutions per minute. The wheel is made in halves fastened together by three 2-inch bolts through lugs, and three 2-inch rods passing over the joint in recesses in the outer edge of the rim; then the ends are turned at right angles and pass through the rim, having nuts on the inside.

Now,—let us assume the rim of the wheel to weigh, approximately, 40,000 lbs.,—which would make the centrifugal force 1,170,721 lbs. The twelve bolts and rods must then hold 372,650 lbs. The cross-section of these bolts and rods, allowing for the threads on the bolts, we assume to be 30 inches; hence the tensile strain is more than 12,000 lbs. per square inch. This is much too high for the bolts, and considerably too high for the rods. There is another point that should be carefully considered in fastenings of this kind. That is, the rods referred to are not likely to get much strain until the joint has opened somewhat, while the bolts are screwed tight and have considerable initial strain. This may throw nearly all the duty of holding the halves of the wheel together on the six bolts, already weakened by threading. The above is a more or less true consideration of the facts, and depends largely upon how well the rods are fitted and put into place. The wheel, possibly, would

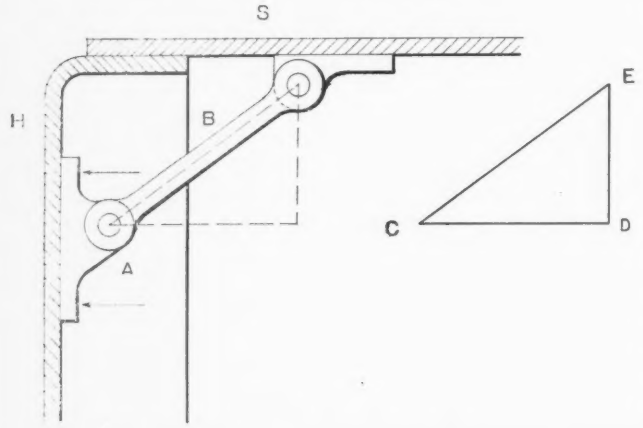
run for years, but if such a wheel was substituted for the one on the engine I am in charge of I would hunt another job. So far as the rim of the wheel is concerned, making allowance for the holes for the rods, the breaking strain will be less than 1,200 lbs. per square inch; hence this part of the wheel should be quite safe.

Yis an I niver see a built-up fly-wheel yit whot bursted but whot it give way in the fastinins. Be gob I don't believe the mechinist is a bether facthor of safity nor a casting whot looks sound on the inside but is full of sand holes an internal strains on the inside of it.

I don't know Dennis if you are altogether fair to the machinist, it seems to me that most mechanics are rather proud of doing a good job.

Yis an now ye are admitin me argiment. Most mechinists is a doing good jobs an so is most castins good castings, but once in a while the mechinist makes a fit jist as little too loose, an then he says let her go, no one will ever know, and there he is like the castin I was talkin about.

All right Dennis, I give in, not because you are right, but I want to show you fellows that was not at the council meeting last night what a treat you missed. You all know Jim Dugan, well he was there and operated on the black-board. Here is the



question he propounded: Give me a rule for computing the stress brought to bear on boiler braces at different angles. In order to give an intelligent answer, take the following example: Let S represent the circular shell of a boiler; H a head, which is flat and must be stayed; B one of the boiler braces, which sustains the head H; and let the pressure at A, which the brace B must resist, be equal to 10,000 pounds acting in the direction of the arrows. The question now has resolved itself into: What will be the stress on the brace B.

It was shown that this problem can be solved in two ways—first, by a graphic construction, and secondly, by calculation.

First, by the graphic method: Draw a horizontal line C D; the length of this line must now be made to represent the given pressure of 10,000 lbs. This is best done by adopting a certain length to represent a certain number of pounds; thus, for instance, we may say that ½ of an inch is to represent 10,000 lbs., or ½ of an inch is to represent 5,000 or 500 lbs., or ¼ of an inch may represent 10,000 or 500 lbs. In fact the amount of pressure that 1, ½, ¼ or ⅛ of an inch is to represent is a matter of choice. Let us adopt ½ of an inch to represent 1,000 lbs. Now since the line C D must represent 10,000 lbs. we must make the length from C to D equal to 5 inches—that is $\frac{1}{2} \times 10 = 5$ inches.

Through the point D draw a line E D perpendicular to C D, and through the point C draw a line parallel to the brace B cutting E D at the point E. The length of the line C E will represent the stress brought to bear on the brace B in resisting the 10,000 lbs. pressure at A. Now, since every ½ of an inch on the line C D represents 1,000 lbs, every ½ of an inch on the line C E will also represent 1,000 lbs, and consequently, if the line C E measures 5½ inches, which is equal to $\frac{1}{2}'' \times 11$, we conclude that the stress in this brace B is 11,000 lbs.; or, if the length of the line C E is equal to 5¾ inches, then the stress in the brace B is equal to 11,500 lbs. In short, the stress in the brace B is to the pressure at A as the length of the line C E is to the length of the line C D.

If the stress in the brace B is to be found by calculation, we construct a triangle C E D as before. This triangle will be a right-angled triangle, and consequently we can find the length of the line C D by the following rule: Add the square of the line C D to the square of the line E D; the square root of the sum will be the length of the line C E. If the length of this line is found to be 5½ inches, and we have adopted ½ of an inch to represent 1,000 lbs., then the stress on the brace is equal to 11,000 lbs. Time to blow the 10 minute whistle. Hustle, everyone of you.

—o—

Economy.

By C. W. Dunlap.

I was told by the general manager of the "stogie" factory that I was using a great deal of water and to try and economize on it if possible; in other words to look at the water piping and see if there were any leaks. I made a thorough search and found no leaks worth mentioning and reported the same back to the manager. The plant consisted of a battery of four horizontal tubular boilers 56″ x 18″, each boiler having 34—4″ tubes, and rated to develop about 75 horse-power each. These boilers were used for heating the factory and furnishing steam for engines in another building where stampings were made in sort of a machine shop. Both shops being under the one management, two of the four boilers were ample to keep things going during the summer months, but it required three in the winter time. At the time I speak of 'twas the first month in the winter that we had had three boilers in service, and also my first month in the employ of the company. Right here I will say that I had sized up the manager as a crank on economy and that he would do a *great deal to save a penny,* regardless of the cost, etc.

At my first examination of the boilers I noticed at the back end there was a brass plug 2″ in diameter screwed in the head alongside of the hand-hole plate on each boiler, and I surmised that here was where the blow-off connections had been, were, or intended for, but someone had changed them to the bottom of the shell. After some calculating, I conceived the following arrangement: From each 2″ hole in the back head of each boiler I put a piece of extra heavy pipe straight out through the brick setting, making sure to cover this pipe where exposed to the intense heat of the combustion chamber with 2″ of asbestos covering. I made sure that it would keep the fire from the pipe, as this pipe would surely be a dead end when not in use. On the end of the piece leading from each boiler I put a 2*

Jenkin's Globe Valve and a service ell leading down from this. I screwed a piece of 2″ pipe long enough to reach within four inches of the floor. On the ends of each piece of pipe I put another ell, and into these ells I screwed the male end of a service ell (2″), then a nipple, then a T on each one with a 2″ brass-box union. Between each boiler connection I connected up this conductor pipe, or blow-off, whichever you may call it, and led the pipe through the wall into the engine-room, where a small 6″ x 9″ center-crank slide-valve engine operated the machinery in the stogie factory and drove the dynamo for lighting purposes. This engine exhausted to the atmosphere through a back-pressure valve, which maintained about 3 pounds on an open heater. This heater received the returns from the heating systems of both buildings, and the exhaust from the small engine tended to heat the water to about 190°F.

Now a great deal of steam escaped from these two buildings in different ways and the result was that quite a bit of fresh cold water had to be put into the heater from time to time to keep up the supply to the boilers and, by the way, the exhaust from the feed pump was forced through the heater with a back-pressure valve also. Now the sediment or scale-forming matter in the water compelled me to clean one of these boilers every two weeks; so by connecting up this auxiliary blow-off pipe, I could use the water that remained in the boilers after they were cut out. This water would remain hot a long time after the boilers were cut out, and hot water admitted to the heater would make a saving not only in fuel, but the water contained in each boiler amounted to a great many gallons in the course of a year. When I cut out one of the boilers and cut in the other one the steam would remain in the one cut out a long time, sometimes twenty-four hours. So from the dome of each boiler I connected a line, arranging it for expansion and putting a valve or stop at each dome. I led this line to the cold water supply pipe leading to the heater, and connecting it into a Y fitting and a check between the supply valve and heater. With a valve in this line I could use the steam left in the boiler that was cut out. This steam had a tendency to save also, for it heated the cold water going from street mains to the heater direct.

Some may think this an expensive undertaking, but with all of the fittings at hand, all it cost the company was a new set of pipe cutting and threading tools. There must have been some economy in it, for when the water man read his meter at the next regular monthly reading, he said that we were not using near as much water as before. There was also a saving in the fuel, because when the manager checked up the coal report he had a smile on his face; something very rare for him. It is a nice thing to have the boss say, how is it George, you haven't used as much coal this month as last, and you are doing more work? In practicing economy in a steam plant I always find it brings good words from the man that pays the coal bills.

———o———

High Pressure Gas Distribution at St. Louis.

A gas power installation of exceptional interest is now under construction at St. Louis, Mo. The system has for its object more efficient distribution of gas over larger areas than may be economically covered by the simple method of running large low pressure mains from a centrally located gas generating plant to supply all parts of the city. The system under construction is intended to supply the entire city of St. Louis, embracing an area of approximately 65 square miles.

It is evident that in order to serve the outlying districts of such an area, one of three methods must be employed: 1st, large low pressure feeder from central holder to center of district to be covered; 2nd, medium sized feeders from main holder to auxiliary holder in center of district; and 3rd, high pressure feeder to distributing center, using pressure reducing valves at this point for obtaining proper pressure upon the service lines. The enormous expense for construction entailed by the first two methods has practically prohibited their use in St. Louis, and the high pressure system is being installed. With this system, the size of feeder pipes is greatly reduced and the necessity of auxiliary district holders is entirely done away with.

For serving suburban communities, lying far beyond the city limits, this method may be extended and the pressure of the gas raised to any desirable extent for transmission through small pipes, this pressure being reduced at the suburban distributing center by pressure regulators, as in the medium pressure system above mentioned.

This gas distribution system as a whole presents a striking similarity to the ordinary alternating current distribution system with primary high pressure feeders, reducing transformed and secondary low pressure distributing lines, the theory of high pressure transmission being in both cases identical.

The pressures to be employed in the system under construction at St. Louis are approximately 5 lbs. per square inch for the medium pressure feeders and from 20 to 80 lbs. per square inch for the high pressure suburban feeders. On account of the use of cast iron mains, the 5 lb. limit was chosen for the medium pressure system, but for the high pressure system iron pipe with screwed fittings will be used. With this construction any desirable pressure may be carried with entire safety and the radius of distribution extended to 100 miles if necessary.

In the medium pressure system, the gas pressure will be supplied by a blowing unit, direct driven by a 300 H. P., Westinghouse, horizontal gas engine. The engine has two double-acting cylinders, 16½ inches in diameter and 24 stroke, arranged in tandem with a single crank. The engine uses for fuel the ordinary illuminating gas such as is distributed to customers and draws its supply directly from the gas main. The engine operates upon the four-stroke cycle and the method of governing secures a constant quality of explosive mixture at all loads, the quantity of the mixture being proportioned by the governor to the load on the engine. Electric ignition is employed.

In this particular installation the engine is controlled by an automatic pressure governor which adjusts the speed of the unit in direct proportion to the demand for gas, the speed thus being in inverse proportion to the pressure in the distribution main. So sensitive is this control that the variation in pressure will not exceed 8 ounces for a 50 per cent. range in gas output.

The regular centrifugal speed governor is, however, also used in order to prevent, under any conditions, the engine running at excessive speed.

LETTERS FROM ENGINEERS

IN ORDER to make this department of THE PRACTICAL ENGINEER as interesting as possible, a moderate rate will be paid by us for all contributions published under this heading. However, we do not assume responsibility for the ideas or opinions expressed. None need hesitate to contribute because of inability to draw or write well. We will redraw or revise whenever necessary—it is the idea we want. New ways of doing old things, criticisms of accepted theories, and general engine-room experiences are especially solicited.

Horse-Power of Simple Engines.

EDITOR THE PRACTICAL ENGINEER:

From time to time we find the following question asked: What is the rule for determining the horse power of an engine? Some answers quote the formula

$$\frac{PLAN}{33000} = H.\ P.$$

Where P equals the average pressure, L equals the length of stroke, A equals the area of piston head and N equals the number of revolutions per minute. There is no reference to the area of the piston rod in the above formula. It is supposed that the above formula is close enough for all practical purposes and that the power lost by the piston rod can be dispensed with. In buildings where manufacturers hire steam power we find the area of the piston rod enters as a factor in determining the amount of power used by each tenant. It is customary in making calculations for power to subtract half the area of piston rod from area of head and proceed as if the area of piston head offered no further surface for the steam pressure to act on.

Let us assume that we are required to find the horse-power of an engine whose dimensions are as follows: Diameter of cylinder = 18", stroke = 36", average pressure = 45 lbs. per square inch, and revolutions per minute = 90. Area of head will equal 254.46 square inches, number of feet travelled by piston will equal 540 feet. Now putting the above formula into operation we have

$$H.\ P. = \frac{254.46 \times 45 \times 540}{33000} = 187.38$$

Here we see our engine is developing over 187 horse-power. Such an engine as this will have a piston rod whose diameter will probably be 3¼", and in order to obtain the correct power from such an engine, the area of the piston rod must be considered. From the area of the head we must subtract half the area of piston rod. Now the area of this piston rod will equal 8.295 inches and half its area is 4.148. Now from 254.46 subtract 4.148 we have 250.321 instead of 254.46 as mentioned above. The formula will now appear as follows:

$$H.\ P. = \frac{250.321 \times 45 \times 540}{33000} = 184.38$$

instead of 187.38 as given in the above formula.

It will be seen that our piston rod can be considered as an engine whose piston area is equal to 8.29 inches, average pressure equal to 45 lbs. and number of feet traversed by piston equal to 270 in one minute.

The power developed by this engine will equal

$$\frac{8.29 \times 45 \times 270}{33000} = 3.05\ H.\ P.$$

Indicator cards should be taken from both ends of cylinder and the average pressure determined from each card separately, then add the average pressure so found and divide by 2; the result will be the correct average pressure to use in the above formula. Suppose for the sake of illustration the average pressure obtained from the head end of cylinder is equal to 47 lbs. and from the crank end 49 lbs., then

$$\frac{47 + 49}{2} = 48\ \text{lbs.}$$

average pressure, which can be substituted for the letter P in the formula. If the valves are set correctly, the crank end of cylinder will develop the least amount of power, otherwise the crank end may develop the greatest power.

New York, N. Y. W. K.

A Modern Brick Plant.

EDITOR THE PRACTICAL ENGINEER:

In the town where I work, we are building three large yards for the manufacture of fire bricks, a process which is entirely different from making building or paving bricks and they are the most complete and modern of their kind in this country. The main building is 360′ x 70′ with a heated floor for drying the bricks. The engine and boiler room is 30′ x 50′ and the machinery building is 30′ x 90′, three stories high.

The main feature of the works is, that from the time the clay leaves the railroad car until it reaches the moulds no manual labor is required. It leaves the railroad cars, passes through a crusher and is taken by a 63" elevator to the third floor. An 85′ conveyor distributes it to the bins on the second floor from which it passes by chutes to the pans on the first floor, where it is ground. Power pan emptiers are used which empty the ground clay into cars of special construction. The cars dump the clay on the moulders' tables, where for the first time it is touched by hand, hand-made bricks being superior to machine-made ones. When machine-made bricks are required, a machine capable of turning out twenty thousand in ten hours is used.

Lock Haven, Pa. W. A. S.

A Bargain Plant.

EDITOR THE PRACTICAL ENGINEER:

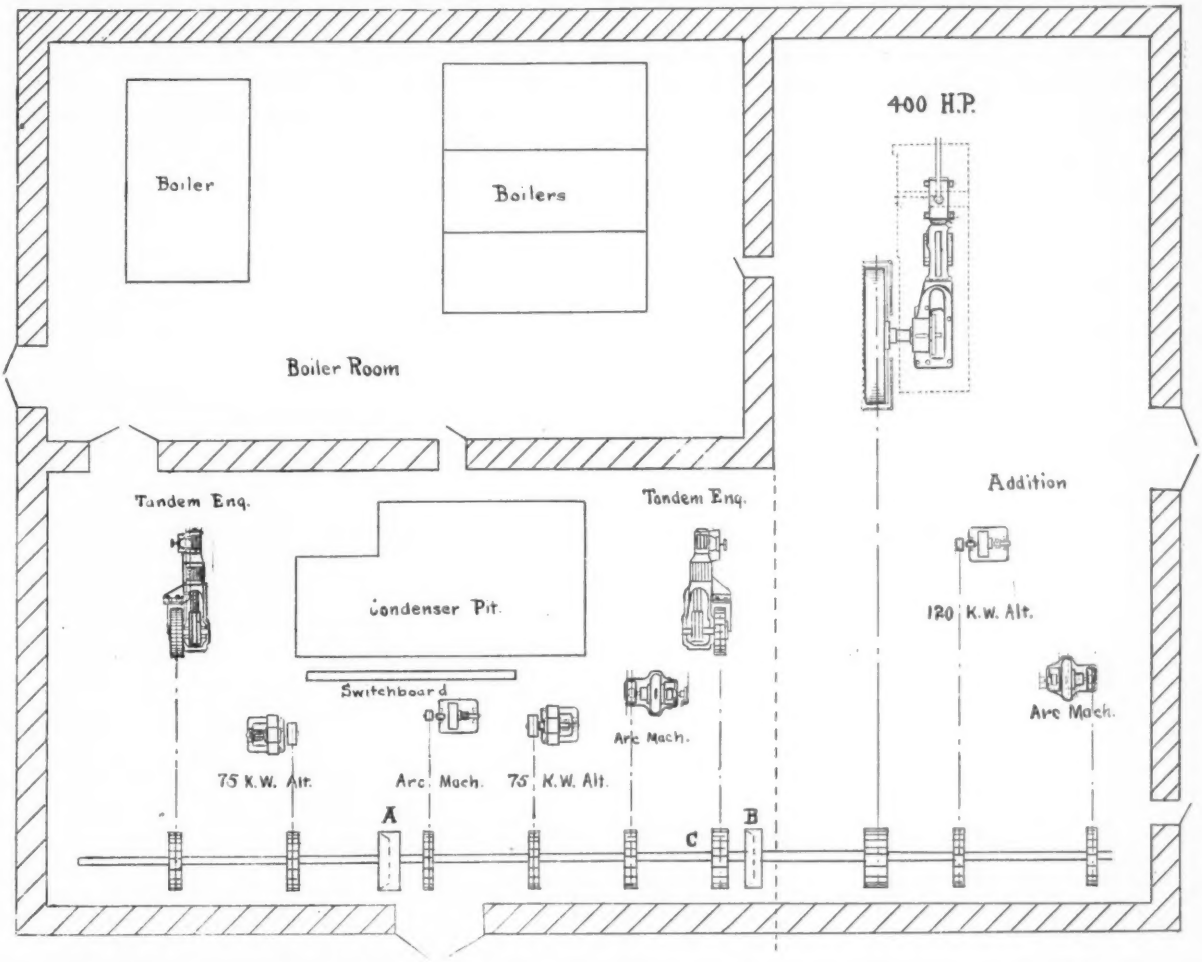
Some time ago, I accepted a position as engineer in an electric light plant. The original plant was composed of two condensing Philadelphia Tandem Corliss Engines, 10" x 20" x 30". One engine was a right hand and the other a left hand engine. A 4-inch diameter shaft with clutched pulleys ran the full length of the building with engines belted to driving pulleys at each end of the shaft. From the shaft were run three Western Electric Arc Machines. The engine room measured 70′ x 65′.

The construction engineer who devised the plan of setting the engines up is entitled to a leather medal as he set the engines 24 feet between centres, ncessitating, after a time, the placing of two idlers on each driving belt; one close to the engine flywheel, the other close to driving pulley, to get some-

where near the rated horse power from each. This plant at the start simply furnished the town with street arc lights of 2000 candle power, and to say they were burning half the night would be stretching the truth. In time, they added a Westinghouse alternator of 75 K. W. and exciter.

As the users of incandescent light and power multiplied, the two engines were not able to handle the load, so something had to be done immediately. By this time a first-class mechanical engineer was employed as superintendent. He advised the directors to buy a new engine, but they bought a second-hand Corliss condensing engine 20" x 48", with a 16 foot flywheel, which cost more to overhaul than it would to buy a new 500 H. P. Cross compound Corliss. When they got this supposed bargain set up they found she would not run. Before they could get her to work, they rebored the cylinder, put in a new piston and rod, a new valve motion, new valves, repaired the governor, put in a new box for the crank journal and repaired the crank. They speeded her up from 65 to 90 revolutions per minute in order to get 400 H. P., making the flywheel run close to the bursting point; lengthened shaft 25 feet; threw out two of the small arc machines, substituting two larger ones and added two new alternators of 75 K. W. and 120 K. W. with exciters.

The new superintendent saw that this rejuvenated scrap pile was set up as shown in sketch. At (A) the shaft is cut in two and a clutch put in so if anything happened to the large bargain unit they would be able to worry along with the two old small units. Between the large and small units the shaft was connected at (B) by another clutch. The position of the engines leaves a loose pulley at (C). This loose pulley was a source of trouble to the previous engineer, whose place I took. You could boil a dinner on it while feeding two cups of grease a minute. It would have been just as easy to keep a red hot furnace cool. The first night I broke in, they were telling me the trouble they had. I asked the day engineer if nothing could be done to remedy it. He said, no let her get hot, don't worry, she has run three years that way without much damage. Keep the grease on her, that will do. I was not satisfied with this but raised the pedestal a few inches thus relieving the strain from the top box. The trouble disappeared and we now use only 5 ounces of grease in nine months.



Upper Troy, N. Y. A. K.

The Way Some Things Are Done.

EDITOR THE PRACTICAL ENGINEER:

The writer has had considerable experience with engineers, working as an assistant and also having charge of engineers. I always find every man has his own idea the way of doing his work and I often think many have a poor as well as a dangerous system of doing.

The writer at one time had charge of a plant and on this occasion I had to work all night with a machinist repairing a break down in the factory. The assistant engineer came on about daylight to heat up the factory. The assistant not knowing anyone was about proceeded in his usual way to get under way, as he would have to hustle to have the place warm in time for starting. This man, I noticed, had steam up on the factory and to my surprise he was only opening the water glass valves, and as it happened he had just begun on No. 1 boiler, No. 2 had not been opened. I quickly examined No. 2 and found these closed also. I turned to this man and asked him if this was the way he had been doing. He said I have tried the cocks before starting. Well, why did you not open the top and bottom valves on the water glass while you were about it? I inquired. I always leave that until after I get started, he replied, as I gain time that way.

Now the writer had instructed this engineer to make sure all was right and always before starting to pull his fires over and also to blow his boilers down about a half gauge of water. He had not done as I had instructed him so I gave him time enough on the following Saturday night, for I considered him a very dangerous man, and it was always a question in my mind whether that man had even tried the gauge cocks before he started his fires, and as for blowing the boilers one gauge, this was also neglected.

Speaking of blowing down boilers, as is sometimes done by engineers, reminds me of an engineer who had charge of a plant close to where the writer is in charge of a plant at the present time. I could hear this engineer blow off a quantity of water every morning about 9 A. M. It seemed to start so sudden at full head and stop just as quick. I became curious to know how this fellow handled that valve. So one morning I made it my business to be on hand to see the operation performed. As I was entering the fireroom he was about to blow down some. As he began, I went out to the blow-off valves to watch how it was done and just as usual it went off with a bang and was stopped in a like manner.

I thought a few words of advice to this young man on the matter would be a good thing, so I mentioned the fact and explained to him what might be the result of continuing this practice indefinitely. I explained to him also the practice was dangerous, to say the least, and if he had had a plug cock instead of a globe valve chances are he might have torn the pipe from the fitting or burst some of the fittings from the water ram he was making of it.

To see what a dangerous practice it is to handle a valve as this young man was in the habit of doing, suppose we take for an example a boiler fitted with a plug cock and having 80 pounds steam pressure, and the cock is opened full head very suddenly, then it is easy to show by the principles of hydrodynamics that if friction be disregarded the water that escapes through that blow-off will have a velocity of about 110 feet per second. Now while a column of water is moving with or about this velocity, let us suppose this plug cock is suddenly closed. The very considerable momentum of the mass of moving water in this pipe is sure to make itself felt, and the energy of this mass of water due to its velocity of 110 feet per second is expanded upon the pipe and fitting, which produces tremendous strains.

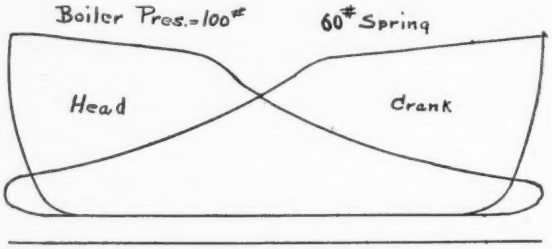
It will break fittings and also has been known to burst pipes and tear pipes loose from the fittings, but is more liable to burst a fitting or a pipe than anything else. The proper way to use a blow-off valve or cock is to open and close slowly and this should be always remembered.

Abington, Mass. A. T.

Indicator Cards.

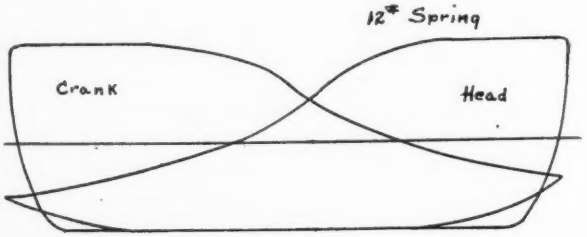
EDITOR THE PRACTICAL ENGINEER:

In the December number of "The Practical Engineer" I saw Mr. C. W. B. Mc. C. indicator diagram of a cross compound Corliss engine 24" and 46" x 48", asking for information. I will try to help him out and if I am not right would like someone to tell me where I am wrong.



The diagram of the high pressure cylinder is very good and cannot be improved to any great extent. The cause of the dropping of the steam line is an indication that the connecting pipe and passages are too small for the piston speed and diameter.

The diagram of the low pressure cylinder indicates that the release does not take place soon enough, causing the pressure to hold up to the end of the stroke. It should form a line similar to the high pressure card. This may be corrected by setting the eccentric ahead, making both release and compression earlier.



Elgin, Oregon. J. G. B.

Rodney's Troubles.

Or Do We Need a License Law in Michigan?

(Sixth Letter.)

Mistur editur, deer sur, it hez bin sum tim sense i rit tu u and ma bee u think i furgot about riten but ure rong fur az u no i haint uzed mi injin mutch this wintur on ackount uv the big sno heaps and big winds, and tu, it hez bin aful kold in theas parts so a fellar woodnt dast tu stur out mutch. but las wensday henry went up to the lecktrik lite stashun in our town and when he wuz thear he sed thet sum fellars wuz testen the injins and thet he herd a fellar say thet he wus taken a card off ov the injine. henry says thet the fellar kud reed rite off ov the card jist whut the injine wuz doen, henry sed the fellar wus tellen about kooshen and kumpreshun and vackum and bak

preshur, and lode line, meen defektive preshur, and henry sez tha mezzured the dooty ov the injin in fut pounds ov wurk. pleeze mr editur explane thease things tu me fur i hev an aplekashum at the lecktrik lite stashun fur a job az engernear and ef i git it i wil rent mi thrasher injin to lem hoversak doun at warfels korners. henry sed thet 1 ov the fellars hed a string tide on tu the watter glas on the biler and when henry askd him whut it wuz fur he sed to keep a sertin leval awl thu tim. now mr. editur how kud the fellar hold the watter in 1 plase in the biler with a string tide around the watter glas, fur if i kud du that on mi thrasher injin ide thro the pump away or sel it tu a junk pedlar. plieze anser this kwestun az sune az u kin. henry sez that tha wade evri bit uv the watter tha uzed and wuz mitey purtikler about it and henry sez thet sum of the fellars wer arguen and arguen about the amount ov watter devapuratid in a our akorden to the kole uzed.

now mr editur dont u think that thay wuz verri fulish tu argu about the watter, when the villidge gits it frum the oggal krick fur nothen. dont u think thet tha wuz very foolish to be blusterin about the kole when the villidge pase fur it. and the fellars made the firesmen taik the ashs frum the biler and way em. now i kant se whut that wuz fur. tha surly koodent be enny moar gud to uze aftur tha wuz burned out. kood tha mr. editur. henry sed thet in the lecktrik lite stashun tha hed awl the pipes kuverd with sum kind ov white stuf, and whun henry ast thu fellar whut it wuz fur he sed it wus a non kon duktur ov heet, now mr. editur this iz a stikker and i wud lik to get a gude ansur fur it, that iz ef u ken, and ef u kan't why pas it on tu 1 ov them kolleg institoots whear sich things is pla fur them tu ansur. i wil rite u a coppee of mi ap le kashun fur the job at the lektrik lite stashun and u kin tel me wethur ile stand a sho fur the job or not.

tu the Mr. sooperue tendnt ov the
orkners villidge lecktrik lite kumpny
dere sur

i wud lik a job in ure stashun as a engerneer i hev had a thrashen injin tu run fur 5 yeers and i nevar had no trubble, i kin fire a biler and keap up steem and i kin maik a pump wurk. i hev run mi injin in awl parts ov munroe kountee. i hev firde in a coke uven, and firde with straw and wod and kole.

pleese giv me a trile
Rodney Gumkirk.
Orkners Korners
Munrow Kounty.
Meeshigan.

cair my fathur.

Poor Cylinder Oil? Remedy.

EDITOR THE PRACTICAL ENGINEER:

A month ago or more I was called into a local plant to make good some cylinder oil that I had recommended to the engineer in charge. He told me that it worked first rate everywhere but in the boiler feed pumps and it would not lubricate the cylinders of the pumps at all. The engineer took me to the pump room where there were two 6" x 4" x 6" duplex boiler feed pumps. One of the pumps was in service and working very slow, and sure enough at each stroke of either piston the pump would groan as if there was no oil in the cylinder at all. The engineer told me that he used 3 pints in 24 hours. I carefully examined the pump that was idle and found that the cylinder had been getting plenty of oil, there were no signs of the rings cutting, in fact nothing to show that anything was wrong except the groaning which would drive you out of the pump room, the sound was so loud and continuous. I was about to suggest to the engineer to call in the oil man and see if he had any better grade of oil that could be tried in the pump cylinders, when I noticed that one of the boiler-feed pumps was a new one, and I asked the engineer when he had put in that pump, and he said just a few days ago. It was the same day he got the cylinder oil and the groaning commenced the next day or so after he started the new pump. When it began to groan he shut it down as soon as possible and started the other one, and after it had run about six hours it began to groan and for the past few days he had been in misery.

I then told the engineer that I thought the groaning could be stopped by altering the steam piping. In figure 1 while pump A is running, the steam condenses in the pipe from 1" stop valve over pump B at E to the tee at H, the pump running

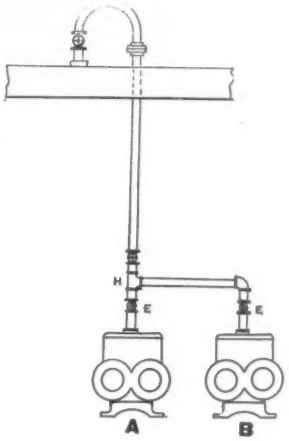


Fig. 1.

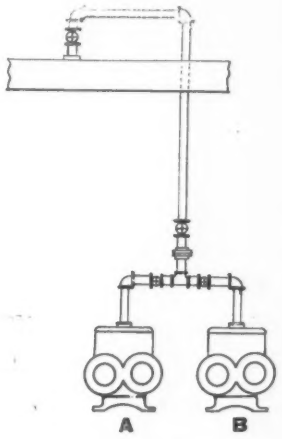


Fig. 2.

very slow naturally drew this condensed steam into the cylinder that was working, and the water had a tendency to wash out all the oil and caused the groaning of the rings. With cylinder B in service the steam condensed in the pipe from the stop valve E to the tee at H and was drawn over into cylinder B, causing the groaning. The change in the piping from Fig. 1 to that as shown in Fig. 2 stopped the groaning entirely and the amount of oil used for 24 hours is ½ pint.

Ark., Wes.

Atlantic City Council.

Atlantic City Council held the first of a series of open social meetings on Tuesday evening, February 2nd. There were interesting talks on engineering subjects and everyone was made to feel at home, cigars, etc., being passed around. This Council will no doubt derive a great benefit from these meetings not only socially but intellectually. Meetings of this kind will be held every two weeks until the summer months.

QUESTIONS and ANSWERS

THE editor will be glad to receive from the readers of THE PRACTICAL ENGINEER, such questions relating to engineering subjects, as may, from time to time, occur to them. All questions and answers should be addressed to the editor and accompanied by the name and address of the writer, which will not be published, however, unless especially desired. It is the intention that questions shall be answered by the readers, and even though the editor may, from time to time, publish answers and questions, he especially desires the readers in such cases to contribute any further information, in connection with the points raised, that they may consider of interest. All questions and answers received by the editor will be published, as far as practicable, but he reserves the right of editing or rejecting any communication.

EDITOR THE PRACTICAL ENGINEER:

I would like to know what size of wire is used for the field coils, also about how many thicknesses and the size of the armature wire of a spark coil or induction coil.

Pottstown, Pa. I. S.

The induction coil consists of a cylindrical bobbin having a central iron core surrounded by a short inner or primary coil of stout wire. This is surrounded by an outer secondary coil consisting of many thousand turns of very fine wire, carefully insulated between its different parts. The primary coil is made of stout wire, that it may carry strong magnetizing currents, and consists of few turns chiefly to keep the resistance low. The central iron core is usually made of a bundle of fine iron wires to avoid the induced currents which would be set circulating in it, and which would retard its rapidity of magnetization or demagnetization. The secondary coil is made of many turns, in order that the voltage may be very high and as the induced electromotive force will be thousands of volts, the resistance of this coil is immaterial, and it may be made of the thinnest wire that can conveniently be wound.—[Ed.]

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EDITOR THE PRACTICAL ENGINEER:

Please answer the following questions for me in your paper:

1. What is lap angle?
2. What is angular advance?

O. Z.

1. The lap angle is the angle through which the crank must turn from its dead point in order to move the valve a sufficient distance to open the port.

2. In order that the full pressure of the steam may come on the piston at the beginning of the stroke, the angle between the crank and eccentric is never made equal to 90° but something greater. The increase of this angle is called the angle of advance and may be defined as the angle between the actual position of the eccentric and that position of the eccentric which would bring the valve to its middle position, the crank being in both cases at the dead point.—[Ed.]

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EDITOR THE PRACTICAL ENGINEER:

I have a duplex pump which pumps water at a temperature of about 200 degrees, but it misses the water when it gets above 200 degrees. I have a chamber on the cover of the water end of the pump 4½ inches in diameter and 3 feet long. It has a pet cock on the top but it does no good. Do you think it will help the pump if I take out the springs? It will pound itself off its base if I do not. I do not think these pumps are good for hot water, as I often must keep the cold water valve open a little. Kindly answer in your next issue.

Phila., Pa. C. L.

When hot water passes through the pump certain conditions arise which must be met by special devices. It has been found that hot water cannot be lifted successfully, because as the plunger moves forward and creates a vacuum in the suction pipe, the pressure being relieved to a certain extent the water will evaporate and the pump cylinder will be filled with steam or vapor, instead of water. To avoid this the pump is usually placed below the level of the water in the supply tank or heater so that it will follow the plunger by the action of gravity. It is also customary to place a pipe with a valve between the heater and the pump, so that any vapor which may collect can be liberated.—[Ed.]

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EDITOR THE PRACTICAL ENGINEER:

Please explain the following: Is it more economical to carry 70 or 80 pounds steam pressure or 20 to 40 pounds pressure with a very light load. A pressure of 20 to 40 pounds being sufficient to run the engine satisfactorily. When I use the higher pressure, I think I use less fuel, because I can throttle the steam at the pump and at 40 pounds I must leave it wide open.

2. Why do steam gauges register wrong up to 15 lbs. and usually all right above that?

3. What is the meaning of the following on a pump:

$$\frac{152 \times 102 \times 152}{6 \times 4 \times 6}$$

4. How do you calculate the size of the cylinders of pump to pump against a given pressure of 80 or 90 pounds?

Papakaling, N. Y. U. G. D.

1. The effect of carrying high steam pressure with an engine very lightly loaded, is to shorten the cut-off to such an extent, that the steam in the cylinder is allowed to expand below the pressure of the atmosphere. The effect of this is to form a loop on the indicator card. This loop represents negative work and should be avoided whenever possible. When an engine is only run lightly loaded at odd intervals, this fact can be neglected, but if run lightly loaded for considerable periods, it becomes a factor for consideration. If the latter is the case, the admission pressure should be so reduced that the engine will cut off later in stroke, allowing the steam in the engine cylinder to expand close to atmospheric pressure. This reduction of pressure may be done either by reducing the boiler pressure or by putting a reducing valve in the supply pipe to the engine. As it is usually more economical to use steam at high pressures in the boiler part of a plant, the latter method would probably be better; that is, carry a regular pressure on the boiler of about 80 pounds and reduce the steam pressure going to engine by means of a throttling valve.

2. Perhaps one reason why a pressure gauge does not read correctly for very small readings, is the fact that it depends upon the expansion of an elliptical metallic tube, in which the pressure produces a proportional movement of its free end. By means of gears, this movement is transmitted to the recording hand, so that if there is any lost motion in this arrangement it is usually more aggravated in the first readings.

3. In some form of later date pumps, on account of the large export trade of this country, the dimensions of the pump are put on the name plate in both American and French units. As there are 25.4 millimeters in one inch, the upper numbers read as follows: Diameter of steam cylinders, 152 millimeters; diameter of water cylinder, 102 millimeters, and length of stroke, 152 millimeters, compared with usual measurements of 6 inches diameter of steam cylinder, 4 inches diameter of water cylinder and 6 inches length of stroke.

4. If the quantity of water to be pumped per minute is known, the area of the cylinder can be obtained by dividing it by a generally assumed piston speed of 100 feet per minute, from which the diameter can be calculated. The diameter of the steam cylinder can be obtained by multiplying the diameter of the water cylinder by a constant which, in the best make of pumps, is about 3-2.—[Ed.]

EDITOR THE PRACTICAL ENGINEER:

Will you please answer the following question through the columns of your paper:

I am in charge of a 75 H. P. return tubular boiler, which is fed on top. The pump that feeds it is a 4½" x 2¾" x 4". Everytime I start the pump to feed it something goes a knocking. It isn't the check valve for I examined it very good. Could you suggest what is the matter?

Hawaiian Islands. J. S. P.

The pounding that you refer to may be due to one of a number of causes. The most usual causes for pounding in a pump have been found to be due to water in steam cylinder, striking of the piston against the cylinder head, broken or deranged water valves or water hammer in the pipe connections. Which of these causes the pounding in your pump can only be determined by examination.—[Ed.]

EDITOR THE PRACTICAL ENGINEER:

Being a subscriber to "The Practical Engineer" I write and ask you the cause of the water hammer or pounding in a 4-inch water pipe leading from a tank to a number of sprinklers in a factory. I have a ½-inch steam pipe inside of the 4-inch water pipe leading up to the tank above the level of the water in the tank and returning to the bottom of the tank. On the top of this pipe is a check valve opening inward.

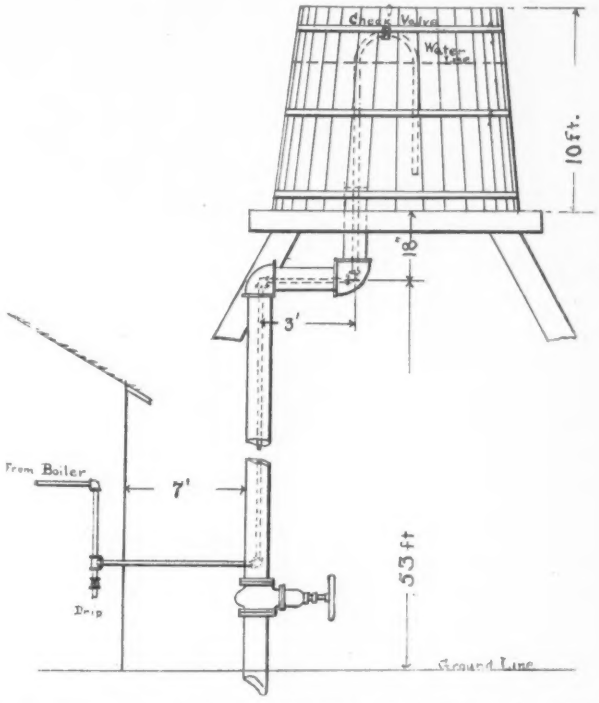
This 4-inch pipe has frozen two different times, the idea of the steam pipe being that when the steam is turned on, it will not only heat the water in the pipe but will continue up and also heat the water in the tank. I filled up the tank with cold water when the connections were completed and turned on the steam. In fifteen or twenty minutes it started to pound furiously. What is the cause and remedy?

The idea of the check valve on top is when the steam is turned on, the check opening inward would close and the steam would continue down into the water and when the steam was shut off, it would open and vent it at the top, preventing the water in the tank from syphoning out.

Danbury, Conn. M. J.

The water hammer mentioned is caused by the condensation of the steam in the ½-inch pipe and as this pipe probably touches the 4-inch pipe, this pounding is telegraphed throughout the pipe system. With such a long pipe as shown of such a small diameter, it is probable that it is entirely filled with the water of condensation before it reaches the top. The steam condensing in the pipe forms an instantaneous partial vacuum which both the steam from the boiler and this water column tends to fill. The steam being the more active gets there first and drives the water for an instant with it. The momentum of this water moving with a high velocity is felt upon any angle or turn in the pipe and hence the hammer blow mentioned. Besides this, the free end of the steam pipe is below the level of the water of the tank and empties into it. When steam is allowed to condense in this manner, a nasty, cracking, vibratory noise is the result.

A probable remedy for this would be to continue the end of the ½-inch pipe in the form of a coil and bring the end



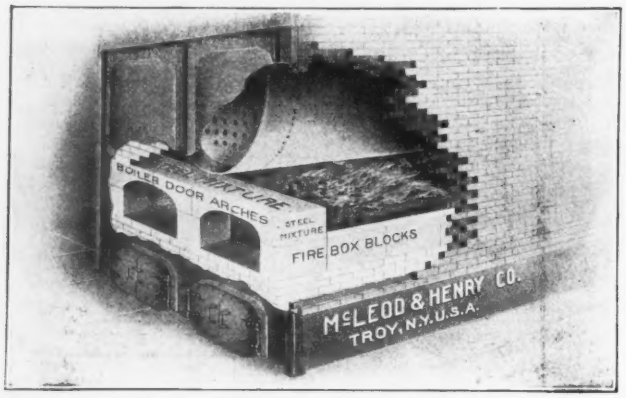
down to ground level with a valve on the end. The valve could be so regulated that a current of steam would always flow through the pipe, or the water of condensation could be led back to the boiler by connecting the return pipe to the boiler below the water level.—[Ed.]

Kensington Council.

A series of lectures are being given by the Kensington Council, No. 3, to which all members of the A. O. S. E. are cordially invited. These lectures are illustrated by stereopticon views and blackboard sketches. On March 10th, an interesting lecture on the "Brief History of the Steam Engine" was given. This will be followed by a lecture on April 7th, on "The Steam Boiler," after which will follow the subjects: "Electricity," "The Indicator," and "Hydraulic Elevators." There will be two lectures on "Electricity" given, the first to be on April 21st and the second to be given on May 19th. "The Indicator" lecture will be given on May 5th and the "Hydraulic Elevators" will be taken up on June 2nd. These lectures have already proved their popularity and a large attendance at each lecture is looked for. They are being held at their regular meeting-place, Frankford Avenue and Master Street.

Boiler Appliances.

A new material for the construction of fire-boxes and furnaces has been developed and is now made by the McLeod & Henry Co., Troy, N. Y. The material, which is known as "Steel Mixture," is formed in Fire-Box Blocks and Boiler Door Arches ready for use, and is claimed to be stronger and more durable, as well as possessing higher heat-resisting properties than ordinary fire-brick.



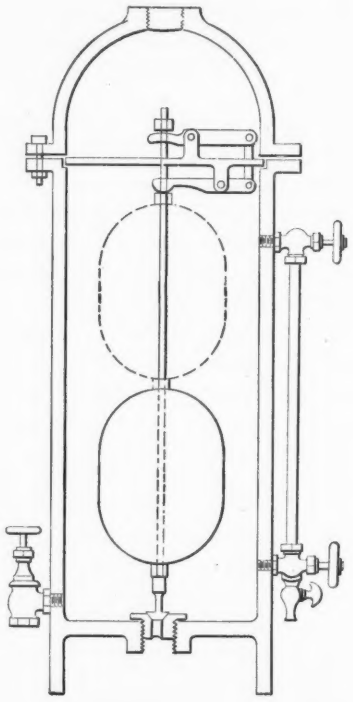
The Fire-Box Blocks are tongued and grooved, and are made in sizes 12 and 18 inches high and 6 inches thick. When in place they make a wall the height of the fire all around the fire-box, and this wall remains smooth and solid, whereas when ordinary small fire-brick is used there is often a tendency for the clay to shrink, thus opening spaces which encourage the accumulation of clinkers. It is said the "Steel Mixture" arches will not fuse until a temperature of 4,000° F. is reached, which is nearly twice the degree of heat that the iron furnace-door arches will stand. "Steel Mixture" fire-brick has been applied extensively and is reported to have proved highly successful.

The Branch Steam Trap.

A new steam trap that is attracting attention is called the Branch Steam Trap and operates upon a somewhat different principle from traps heretofore made. It consists of a cast iron

cylinder with a heavy flange at the upper end, to which is bolted the cap of the trap. This cap is so constructed as to permit either a vertical inlet for the steam, or a horizontal inlet as desired. The working parts consist of a system of double levers operated by means of a cylindrical float with spherical ends through which passes loosely a rod having a valve at its lower end and a collar at its upper end, which is acted upon by the levers. By the ratio of these levers, one pound pressure at the valve rod against the underside of the free end of the lower lever, is equivalent to 5 pounds pressure against the underside of the lifting end of the valve rod at the free end of the upper lever.

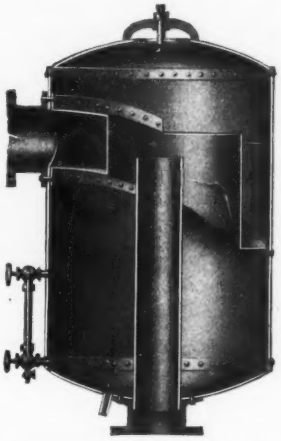
That is to say, when the float is pressing against the lower lever with a force of say 6 pounds, the lifting force of the upper lever on the valve rod will be 6×5 or 30 pounds, which is sufficient to raise the valve, and allow discharge of condensation. The level of the condensation when the float is about to lift the valve is 11 inches above the bottom of the float, which insures the trap to carry at all times plenty of water. The valve will close when the water drops slightly below its level when lifting the valve, the normal line of flotation, thereby causing the float to drop out of contact with the lower lever. The valve is provided with a removable seat, which



can be replaced at any time it should become necessary. The trap is designed to work successfully under all pressures from 1 to 250 pounds and to deliver water against any back pressure not exceeding 3 pounds less than the pressure of steam in the trap. As the valve is water-sealed the entire time it is in operation, it discharges condensation without loss of steam. The valve body and valve are made of phosphor bronze, a metal which resists the cutting of hot water under pressure. These traps are also fitted with mud pockets and blow-off valves, so that they can be flushed at any time. They are manufactured by the National Oil Burner and Equipment Company of St. Louis, Mo.

Steam Receivers and Separators.

Very few persons owning and operating steam plants realize that as ordinarily connected up, the steam storage is often at the wrong end of the pipe. This statement is explained as follows: The steam boiler is constructed for generating steam. The engine is the motor in which this steam is used. The boiler generates steam uniformly and continuously according to the heat unit produced in the furnace. The engine uses this steam irregularly and intermittently, according to the load on it and the revolutions at which it runs.



It is for these reasons that the steam storage for engine use should be close to the engine where it is needed quickly and intermittently, and thus not be obliged to travel through long and crooked steam pipes, at the exact instant it is needed in the cylinder, and then stop suddenly when the valve closes and stops further admission to the cylinder.

When the valve closes this entire column of steam, which has been surging through the pipe at a speed of over a mile a minute is suddenly stopped, only to be instantly started again as soon as the valve on the other end of the cylinder opens, and this is usually repeated hundreds of times a minute.

As a result, a violent vibration is set up in the steam pipe, which often causes leakage. The full boiler pressure cannot be maintained in the cylinder owing to the friction in the pipes not allowing the steam to keep up with the piston, and a loss of power is the result.

The Receivers and Separators here shown are manufactured by Frank A. Simonds of Grand Rapids, Michigan, on the theory and principles above noted. The separator feature is effectual in separating the en-trained water from the steam, thus preventing cutting and grooving of cylinder and rods.

As may be seen from the cuts, the baffle plates and right angle steam currents are dispensed with, and a direct and unobstructed steam passage from boiler to engine is only interrupted by the simple and easy spiral sweep through the separator.

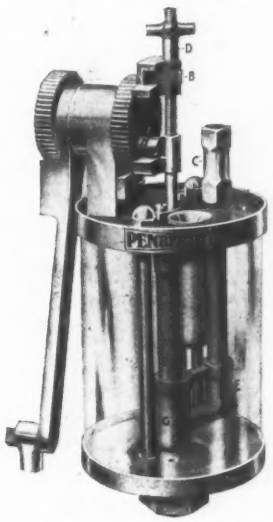
Force Feed Lubricator.

One of the latest inventions in this class of lubricators is shown in the following illustration. Its principal features are first the two ratchets, one of which is used to drive the plunger, while the other acts on the plunger itself, and secondly, the location of the valves which are in the center of the oil reservoir.

The advantage of the two ratchets is that they are interchangeable, and as the wear only comes on the outer ratchet to which the lever is attached, when worn to such an extent that the "dog" will not hold, it can be replaced by the ratchet acting on the plunger, and the life of the lubricator thereby doubled. As the ratchet is the first thing to wear out, this device will be appreciated by engineers.

The advantage of having the valves feed from center of oil reservoir is that they cannot be affected by changes of temperature, and it will therefore feed oils very difficult to feed through hydrostatic cups.

Closing the jaws of the lubricator with the nut B increases



the feed, opening the jaws decreases the feed. When the proper amount of oil is being fed, screw down the nut D to hold rigidly in place. Extra oil can be had by screwing down the nut B and operating the plunger by hand. The cup can be cleaned from a hole in the bottom designed for that purpose. This cup is manufactured by the Penberthy Injector Co., Detroit, Mich., manufacturers of the well known "Penberthy" Automatic Injector.

Growing Uses and Importance of Asbestos.

Asbestos is a paradox among minerals because, although mined like anthracite coal, its fibres when separated by machine from the rock are soft, white and delicate—resembling wool or cotton, though not inflammable. The principal supply of crude asbestos, suitable for commercial use, comes from Canada, in the province of Quebec. It is found attached to a rock of dark green shade, but when detached is perfectly white.

As it comes from the mine it costs $200 per ton, but after separation of the fibres, they are worth $1500 per ton.

The fibres are made into yarn, and woven into cloth in much the same way as is done by cotton. It is then made into packing in various forms, sheeting, tapes, gaskets, and various other uses, as theatre curtains, furnacemens' aprons, leggings, firemen's clothes, gloves, etc.

The important developments in the use of triple and quadruple expansion engines, and high pressure engines generally, during the last ten or twelve years, rendered necessary corresponding improvements in jointing and packing materials, which the New Jersey Asbestos Co. of Camden, N. J., were not slow to see. They at once began the manufacture of asbestos sheeting, spinning a fine brass wire into the center of the threads of both warp and weft, thereby adding great additional strength, and making it capable of resisting the highest pressures. It is rendered waterproof by being coated by a solution of India rubber. This packing met such approval from engineers in general that the firm secured patents on a number of styles of packing and gaskets, and placed them on the market under the trade mark of the "Gladiator" Asbestos-Metallic Goods. That these continue to give satisfaction to engineers is not only evidenced by the additional machinery they keep adding to their plant from time to time, but by the number of firms who are making asbestos metallic packing. The New Jersey Asbestos Co. claim, however, that these are invariably either of foreign manufacture, or made from cloth purchased abroad, and are not to be compared with "Gladiator" Asbestos-Metallic Goods, of which they are the original manufacturers, and the first to introduce to the notice of engineers in this country.

Book Review.

Electrical Engineering Experiments and Tests on Direct Current Machinery, by George F. Sever. D. Van Nostrand Company, 23 Murray St., New York. 64 pages, illustrated. Size 5½ x 8½. Flexible cardboard cover. Price $1.00.

This book, as the author says, is adapted for two purposes, the first one being for students in engineering courses who do not make a specialty of electrical engineering, but who, in the subsequent pursuit of their professions, might be called upon to pass upon the merits of certain types of machines; the second one being for those who are at present pursuing the engineering profession in its various branches and are familiar with the use of electrical engineering measurements and apparatus.

There is nothing new in the book that has not before been written, but as the list of experiments and diagrams accompanying them are very clearly described, it should make a very good laboratory book for electrical engineering students just starting out in direct current testing. Among the experiments described are the application of Ohm's law, the determination of the external and armature characteristic of a shunt dynamo and the method of obtaining its commercial efficiency by the prony brake and stray power methods. The operation of the series motor, which is applied to all street railway cars, is described and the method for finding its commercial efficiency by using a prony brake. The operation of dynamos in parallel is then taken up; also the operation of a constant current arc dynamo. A study of arc lamps concludes the book.

The book would have a greater value if more subjects were introduced or at least if the subjects that are there, were indexed.

Manayunk Council, No. 9.

At a regular stated meeting of Manayunk Council, No. 9, the following resolution of condolence was unanimously adopted:

Whereas, It has pleased the Supreme Engineer of the universe, in His infinite wisdom, to remove from the sphere of his earthly usefulness, the beloved friend, our brother engineer, Elwood Heeps, and while we bow in humble submission to the Divine Will, it is hereby

Resolved, That we express our heart-felt sympathy to the bereaved wife and family of their loss, and be further

Resolved, That a copy of these resolutions be sent to the wife and family and placed on the minutes of the Council; and also a copy printed in "The Practical Engineer."

GEORGE W. RICHARDSON,
FLORIAN J. ARMBRUSTER,
VALENTINE DUTTON,
Committee.

The Coming Convention at Allentown.

Arrangements are actively progressing for the next convention to be held on May 9th, at Allentown, Pa. Lehigh Council, No. 15, are especially pleased with the large number of engineers that have signified their intention of coming to the convention. The Convention Committee composed of A. P. Dreisbach, A. J. Strauss and Edmund Brader, are busily at work arranging for hotel accommodations, entertainments, meetings, etc., and they hope to outdo all the previous conventions in point of numbers and hospitality as well as educational features.

This convention will be the eighteenth annual convention held by the American Order of Steam Engineers, the previous one being held in Pittsburg, Pa. Everyone who was there remembers the good time that they had, and as Allentown is renowned for its hospitality, just as good a time if not better should be looked forward to. The headquarters will be at the Hotel Allen. The convention committee located at 607 Hamilton Street, Allentown, Pa., will answer all further inquiries.

Bathed in Lubricating Oil.

The electric station managers in Southern India have been considerably embarrassed for a long time by the theft of their lubricating oil. It was eventually discovered that a Hindu, according to his religious rites, must take a periodical bath in oil and for this purpose the lubricating oil was as satisfactory as any other and more accessible. It was only by contaminating the oil with animals' blood, thereby making it unfit for use in Hindu eyes, that the stealing was stopped.

Storage Battery Rooms.

In battery rooms all exposed metal work is painted as a protection against acid fumes and the wooden floors are protected against acid. Pure sulphuric acid is used diluted with distilled water to the required gravity. In mixing the two, the acid should be poured into the water. Never pour the water in the acid as a great amount of heat is always given off when these two combine.

TRADE NOTES

The steam separator saves money by saving the water of condensation, entrainment and drainage; by saving the heat contained in said water; by saving the steam systems from water, thereby reducing liability to accident; by returning pure water to the boiler, thus preventing scale; by preserving uniform temperature, thus obviating difficulties due to expansion and contraction; by preventing direct loss which exists from presence of condensation; by enabling engines to start promptly; by maintaining higher pressures at the end of long lines; by increasing the efficiency where steam is used expansively and by reducing the quantity of cylinder oil used.

A treatise on the subject of the Steam Separator, explaining the above, will be sent free upon request by Charles D. Mosher, No. 1 Broadway, New York, to anyone mentioning "The Practical Engineer."

It has been shown by those using the Williams Automatic Safety Feed Water Heater, that its economy in the saving of fuel is at least from 6 to 15 per cent. The only labor required to operate boilers having these heaters is to start the pumps and merely blow out the sediment in the regulators twice a day. Its perfect simplicity of construction makes it last a long time as all complicated parts are eliminated, and besides it contains a high or low water alarm. A booklet describing it is issued by the Williams Gauge Co., 543 Fourth Avenue, Pittsburg, Pa., and can be had on application.

In addition to the manufacture of steam engines for general power purposes, engines for grain elevators and for electric lighting, engines with pumps and air compressors, windmills for all purposes, motors and dynamos, the Fairbanks, Morse & Company, of Franklin and Monroe Streets, Chicago, Ill., have turned their especial attention to the manufacture of hoists and mining machinery operated by gas, gasoline, crude oil or producer gas.

In many places where mining hoists are operated, the principal difficulty experienced is in getting a sufficient supply of fuel or water for steam boilers and often where the water supply is efficient, the character of the water is such that it cannot be used. It is to overcome these difficulties that the Fairbanks, Morse Co. gasoline outfits were designed as the amount of fuel used is small and only enough water is required to keep the cylinder cool.

"Two Minutes of Interesting Reading to Steam Power Owners" is the title of pamphlet just issued by Frank A. Simonds of Grand Rapids, Mich. No two minutes could be better spent than by reading this little book. It is a treatise on some points in steam plant details and is interesting only to owners and engineers that are progressive and are looking for the best results and modern practice. It can be had upon application.

Modern practice in the generation, transmission and utilization of electric power demands alternating current generators of greatly improved design over the old types, which were used for lighting purposes only. An alternator to meet these requirements must be so designed that it is suitable for large currents, very high voltages and varying power factors. The only type that can be suitably designed to meet these conditions is the revolving field type.

The National Electric Company of Milwaukee, Wis., are sending out a well described catalogue explaining this type of alternator which they make up to 1500 K. W. capacity. This company also manufactures direct current motors and generators, synchronous motors, rotary converters, double current generators, motor generator sets, booster sets and power transformers.

Mr, Julius Keller, the well known inventor of the Keller Pneumatic Tools, has purchased the controlling interest in the Philadelphia Pneumatic Tool Company. The company will still continue under the same name, as Mr. Keller has always been and will still continue to be the leading spirit of it. Mr. Keller's success has been very gratifying and it must be particularly noted that he is one of the few inventors who have reaped the profits of their inventions.

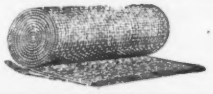
The great success of his pneumatic tools has been the combination of a simple and practical design, with the best workmanship obtainable and it is probable that no other class of machinery is called upon for such exacting service, taking into consideration the necessary intricacy and high grade machine works. A partial list of the Keller tools made by the company include chipping hammers, calking hammers, flue heading hammers, riveting hammers, rotary drills, foundry sand rammers, yoke riveters, wood boring machines and tampers for concrete and clay.

steel piping, etc., are used in connection with these systems. Each order is a large one and speaks well for the Hartford Systems. The Hartford Blower Company design and give estimates free of charge on Exhaust Systems of all kinds as well as heating, ventilating and mechanical draft apparatus and a letter addressed to them as above will receive prompt and courteous attention.

"The Trap that made St. Louis Famous" is the Branch Steam Trap, manufactured by the National Oil Burner and Equipment Co., Holland Building, St. Louis. They are constantly in receipt of letters stating that these Steam Traps are the acme of mechanical simplicity and excellence. Their catalogue, No. 10, will bring some very interesting information about these traps as well as their well known "Milwaukee" Baffle Separators, "Triumph" Centrifugal Separators, and the many other steam specialties manufactured by them.

The Just Mechanical System for cleaning steam boilers is making rapid strides in the hearts of all engineers that see them work. They all long for them when they see the results. This system depends upon the method by which the water is carried from the steaming point, or point of dirt liberation and the dirt is deposited in a precipitating tank, after the change of temperature has separated the liberated matter. The water is then filtered, which frees it from oil and grease or any foreign substance and is then taken by the steam loop back to the boiler. A card to the Just Manufacturing Co., 1215 Filbert Street, Phila., Pa., will bring a description of this system.

The Cherry Chemical Company, 1215 Filbert Street, Philadelphia, Pa., are constantly receiving samples of scale and water from steam users. They make analysis of same, free of charge, and manufacture a special Compound accordingly. It is necessary to send them two ounces of scale, by mail, or one gallon of water.

"Gladiator" Asbesto-Metallic "Gladiator" Asbesto-Metallic "Gladiator"
PACKINGS

Remember the "Trade Mark"

None other Genuine
GASKETS

"Gladiator" "Gladiator"

by express, prepaid. They make the analysis, and furnish a certificate of same.

Several years ago this company decided to manufacture Compound strictly according to analysis. Their judgment has proved correct, as steam users are realizing that the only way to treat boilers is on scientific basis.

Mr, Oliver Braden, Manager, has been connected with The Cherry Chemical Company for the past ten years, and we are pleased to state, has been very successful.

Two recent orders received by the Hartford Blower Company of 128 Suffield Street, Hartford, Conn., were from the Oak Duke Lumber Co., Wellsville, N. Y., and the Pennsylvania Match Co., Bellefonte, Penn. These orders are for the well known Hartford Exhaust Systems for removing the shavings, sawdust chips, etc., from wood working machinery. The Hartford Patent Exhaust Fans as well as the Hartford Cyclone Dust Collectors, galvanized sheet

The Torpedo Fire Tube Scaler, manufactured and sold by The General Specialty Co. of 75 Carroll St., Buffalo, N. Y., is meeting such a large sale that it has overtaxed the capacity of the company's factory to keep in sight of the orders. They report orders from a good many large steam users including the Illinois Steel Co., American Bridge Co., American Steel and Wire Co., American Sheet and Tin Plate Co., International Paper Co., United Zinc and Chemical Co., Cleveland City Forge and Iron Co., etc. The fact that these and other large and smaller boiler plants have adopted the "Torpedo" only after careful consideration and exhaustive tests by mechanical experts is the best kind of testimony to the real merit of this machine.

Dixon's Graphite Pipe Joint Compound is now put up in the very convenient and handy form of Collapsable Tubes of a size that may be readily carried in the engineer's, mechanic's or pipe-fitter's pocket or tool bag. This form is particularly useful for all small work away from the shop or for those who have only occasional need of making threaded connections.

The sales manager of The Republic Rubber Company, Youngstown, Ohio, reports steadily increased demand for their line of Special Packings, Searchlight Sheet, Cross Arm Wire Inserted Tubular Gasket and Firestone Piston Packing. One of their salesmen is quoted as follows:

"We naturally feel jubilant over the fact the merit of our packings has been so readily recognized from Maine to Mexico. Merit will always tell. Testimonials from every State in the Union are tendered us by packing users, who are unstinted in their praise. The souvenir clock that we are distributing among users of our packings is admired as a work of art, as well as a very useful article for an engine room."

Now is the time to make repairs to engines for trolley power service, before the heavy duty required of them all the summer. H. B. Underwood & Co., 1025 Hamilton St., Philadelphia, who have the largest repair shops in the United States are realizing this, as they are sending men all over the United States to rebore cylinders, turn up commutators and in a number of plants, they are putting on their well known St. John's Self-adjusting Cylinder Packing on the engines.

Indicator cards are useless, unless they are drawn by a correct indicator motion and an indicator whose pressures can be relied upon. These conditions are admirably fulfilled by the Bachelder Indicator and Ideal Reducing Wheels. Engineers are learning this more and more and for this reason John S. Bushnell Co., 126 Liberty St., New York, are receiving many orders for this arrangement and scores of letters commending and praising them.

The Crandall Packing Co. of Palmyra, N. Y., are manufacturing high grade packings of all kinds. With the latest improved machinery, skilled labor and years of experience, they are furnishing packings and rubber goods which are very satisfactory to the engineering world. A catalogue will be sent free upon request to anyone mentioning "The Practical Engineer."

James McCrea & Co., Chicago, manufacturers of Steam specialties, have recently received a large order from the Mine and Smelter Supply Co., El Paso, Texas, and have made arrangements with them to handle their line throughout Arizona. They also report a growing demand for their H. H. Steam Trap, which they claim is the most simple in construction and operation of any trap manufactured.

The Garlock Packing Company of Palmyra, N. Y., would like to call attention of engineers and their friends in general to the difference between the pressures at the present date and several years ago. All users of steam are aware that pressures have been increased anywhere from 50 to 100 per cent. within the past few years. At the time that the standard Garlock Packing was first put on the market the pressure rarely exceeded 80 lbs. At the present time 125 to 200 lb.s is nothing unusual. While their standard packing will withstand this high pressure better than any other on the market, it was not intended for so heavy a task. To meet this increased pressure they have been, of late years, creating new packings which are giving high satisfaction throughout the country at present and they guarantee to pack against any pressure required or receive no pay for it. They will be pleased at all times to receive inquiries and communications and take great pains in seeking out and giving them the information that they desire.

If you want to know how packings are made, send for a booklet of Larkins Packings. These packings have been proven to be so universally successful that the Pennsylvania Electrical and Railway Supply Co. of Pittsburg, Pa., will not accept pay for them unless they have given satisfaction. This is certainly a fair offer.

Modern engineering demands a device which shall not only obtain the highest efficiency from the waste heat contained in the exhaust steam, but which shall also eliminate from the feed water all the sediment or impurities contained therein, before it goes to the boilers.

For twenty-five years I. B. Davis & Son of Hartford, Conn., have made this study their specialty, and have adopted such alterations and improvements to their well known Berryman Feed Water Heater and Purifier that thousands of users from Maine to California and from the Great Lakes to the Gulf stand ready to give it their endorsement.

Mr. G. F. Duemler, who has the Philadelphia Agency for the Dearborn Drug and Chemical Works, has been very happy for the past few weeks, as he reports a constant increase of orders to his firm every week. The Dearborn Drug and Chemical Works know how to clean boilers of scale for every individual case. Send a gallon of water for analysis.

Have you made a "Guess for Gold" yet? It is very easy. All you have to do is to send a Eureka Coupon, which comes with Eureka Packing, with your guess as to what you think the number of admissions will be to the St. Louis Exposition, on July 4, 1904. The three nearest guessers will get $200, $75 and $25 respectively.

One of the most important branches of steam engineering is steam indicator work and it is becoming daily more important, to the extent that it is almost impossible for an engineer to

STEAM PUMPS for

If you wish a pump for feeding boiler, for tank service, for pumping beer, whisky, oil, milk, hot or cold water, condensations, vacuum, air, jet condensers,

WILL-NOT THE SHORT-STROKE
"GREAT BURNHAM"
STEAM PUMP
Battle Creek, Mich. U. S. A.

EVERY SERVICE

hydraulic pumps, artesian or deep well engines, etc., etc., write address

"UNION"
BATTLE CREEK, MICH., U. S. A.

secure and hold a position as running engineer without some knowledge of this branch of the work.

The Indicator Instruction Company, of Scranton, Pa., are teaching one of the most valuable courses in Indicator Instruction, as all the members of the teaching body are thoroughly practical men and are familiar with every detail of the indicator from its manufacture to its varied uses in every particular.

The subject of indicating the engine will be taken up carefully from the point of tapping the cylinder to the taking of the diagram, either from one instrument or from two or more simultaneously.

Diagrams of various kinds and from all types of motors will be shown, and while not so important, some space will be given to "freak" cards, such as engineers delight in carrying, to "stick the other fellow."

One of the most valuable features of this course will be the papers devoted to experiments of various kinds, some of them having been made at great expense, and only possible where an exhaustive knowledge of the subject is combind with unlimited facilities and the possession of a great number of instruments. Some of these experiments will entail the partial or total destruction of the instrument, and in this branch of the work instruments will be handled "regardless of their feelings," to show the points which affect the diagram and that some, which are ordinarily considered very grave, do not result in inaccuracy, at least to any great extent.

A certificate will be given graduates, showing proficiency. The instruction papers will be written by Mr. A. C. Lippincott, and difficult questions will be answered by him, which is a guarantee of reliability.

FOR SALE. The plant of the Hazelton Boiler Co., at East Rutherford, N. J., consisting of boilermakers machinery, tools, fixtures, etc., also patents, trademarks and office furniture. Apply to

JOHN L. JOHNSON, Receiver
Room 616 Prudential Bldg., Newark, N.J.

Salesman Wanted

We have some desirable territory to be covered and are desirious of taking on a couple of "Up-to-now" STEAM SPECIALTY MEN. Address

THE WILLIAMS GAUGE CO.
543 Fourth Avenue - - Pittsburg, Penaa.

IF ENGINEERS will send $1.00 to the address below they will receive two blue prints, with tables and instructions, showing how to set valves and eccentrics on Corliss engines, simple and compound, with one and two eccentrics.

JOHN T. LINDSTROM,
214 and 216 S. 3d St., Allentown, Pa.

WANTED ENGINEERS... AND SALESMAN

To handle France "Steam Stopper" brands of Metallic and Fibrous Packing as a side line. Good inducements to right party. Address

FRANCE PACKING COMPANY,
TACONY, PHILA., PA.

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ORGANIZED APRIL 27, 1886.

An Order of Engineesr for Engineers and Engineers only.

DECLARATIONS OF PRINCIPLES

Believing that ability will bring its full value in this country, this Order shall at no time take part in strikes, nor in any way interfere between employer and employees. Recognizing their identity of interests, it shall take no part in any project or enterprise that shall interfere with perfect harmony between them ; neither shall it be used for political or religious purposes.

These principles shall not be amended or repealed except by unanimous vote of the Order.

Any member who shall be guilty of violating the principles of the Order shall be expelled.

OBJECTS.

First.—To promote a more thorough knowledge in its members of theoretical and practical steam engineering.

Second.—To assist members to obtain employment.

Third.—To help the sick, injured and distressed and bury the dead.

Fourth.—To establish a Widows' and Orphans' Fund.

Fifth.—To help members who shall become incapacitated from following the profession to obtain employment suited to their affliction.

Sixth.—To do our utmost to extend the license law throughout the United States.

Seventh.—To establish schools in which our members may study the highest branches of steam engineering.

MEMBERSHIP.

An applicant for membership must be an engineer between twenty-one and fifty years of age, and must be a white male citizen of the United States, of good moral character and be a believer in the Supreme Being, and be free from all physical infirmities.

He must have had three years' service in an engineering department, or if a machinist, or graduate of a technical institute, then one year's service, in such department, and in localities where engineers are required by law to be licensed, they must have such license, and must satisfy the investigating and examining committees of the council to which he applies as to his character and ability.

LIFE MEMBERSHIP.

Engineers who have passed the age limit may be admitted to life membership. They must possess the same qualifications and pass the same examination as are required in the next proceeding clause: They shall be entitled to all rights and privileges of the Order except they cannot vote on financial questions or for the election of officers or be entitled to any sick or death benefits.

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The Publication Committee of "The Practical Engineer" desires that the Corresponding Engineers of all Councils of the American Order of Steam Engineers send the name of their Chief Engineer and their own name and address, together with the time and place of meeting, to the Secretary of the Publication Committee immediately after each election of officers. Address, W. S. Wetzler, Secretary, 3717 Aspen St., Philadelphia.

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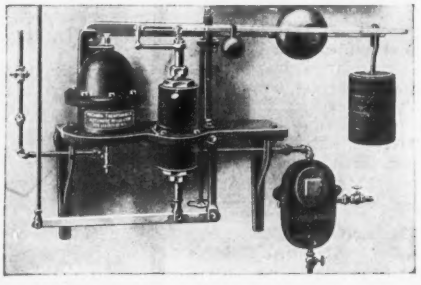

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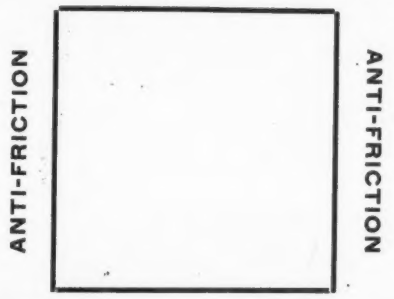

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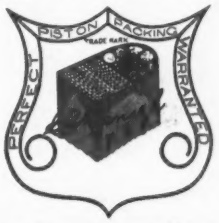

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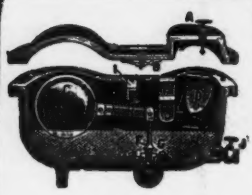

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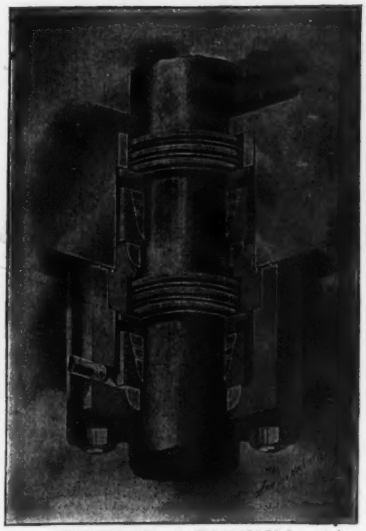

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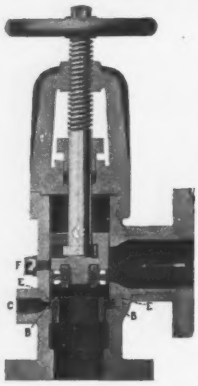

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washes its face every time it is opened and closed.

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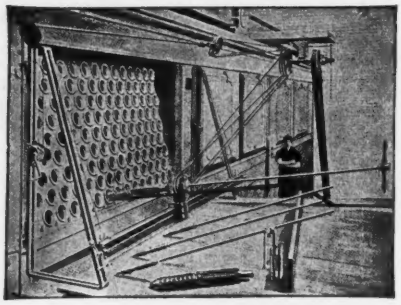

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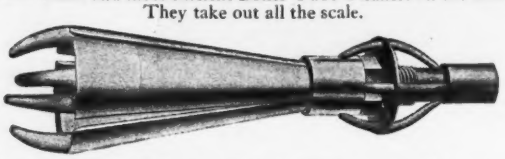

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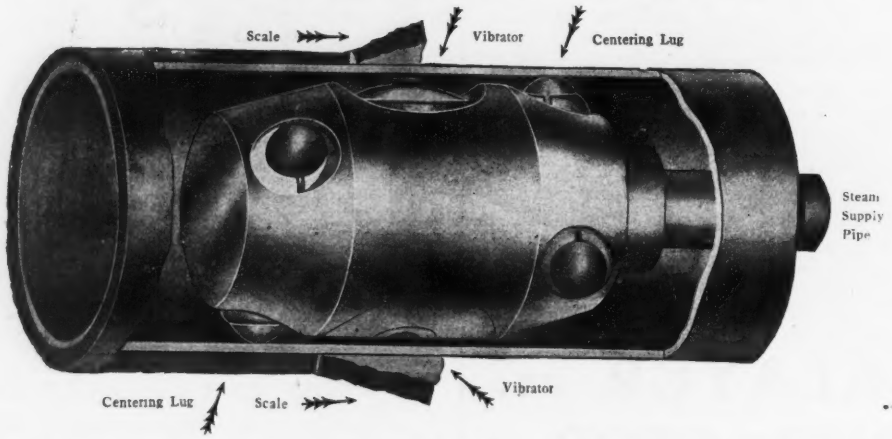

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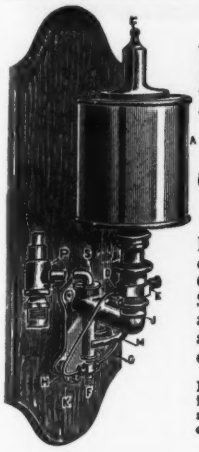

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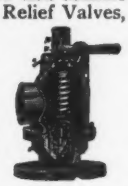

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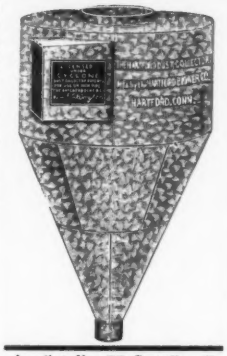

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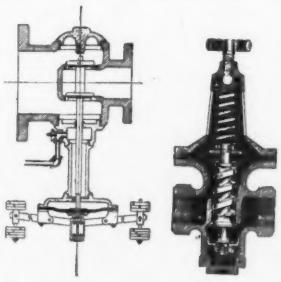

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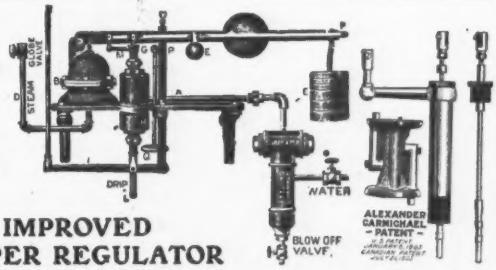

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THE PRACTICAL ENGINEER has been published regularly for a little more than seven years, and it is gratifying to note, among the renewals coming in during the past month, the names of many of our readers who have stood by us constantly from the beginning—a very small beginning at that.

To all these old friends we extend our sincere thanks, for without them The Practical Engineer, as it is to-day, would have been impossible.

To the six or seven thousand new readers that have been added to our happy family during the past year we extend both thanks and congratulations. We thank you for your confidence in us and congratulate you upon getting greater value than has ever before been offered to Engineers for Fifty Cents.

The Practical Engineer is growing larger and better very rapidly. Sixteen pages and over six thousand new subscribers were added in 1903. No other engineers' paper increased half as fast during the same period, but if our new readers will do as our older one has done—recommended the paper to their engineer friends and secure us more new subscribers, it will grow much faster in 1904, and all will be benefited. We want you to do this and, in order that you may not spend your time in our interests without compensation,

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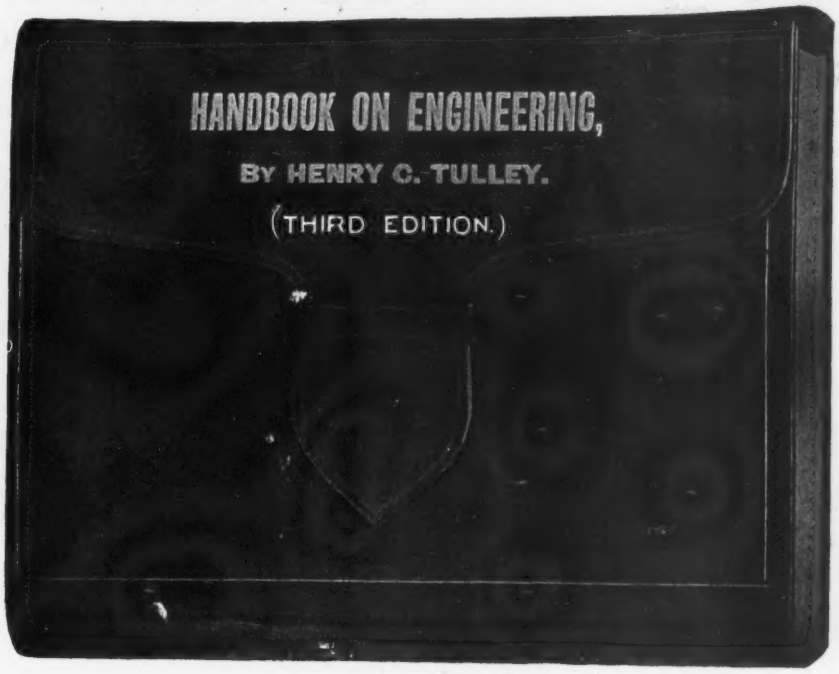

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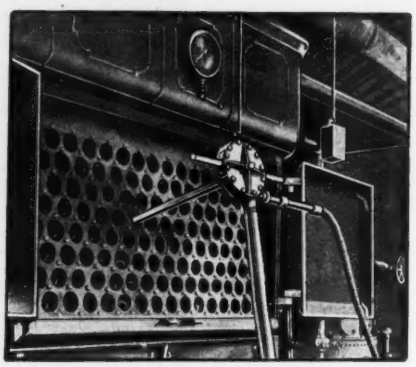

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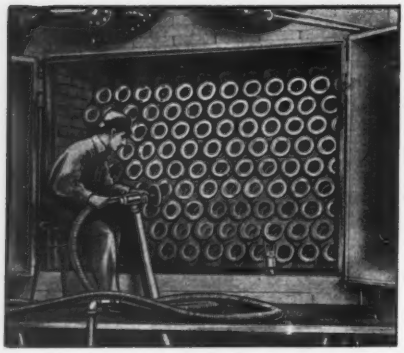

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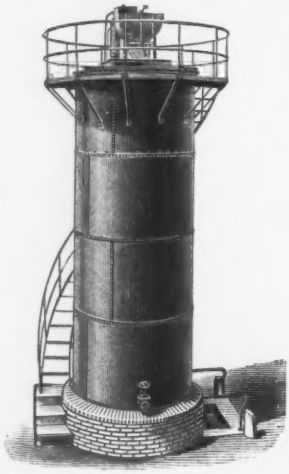

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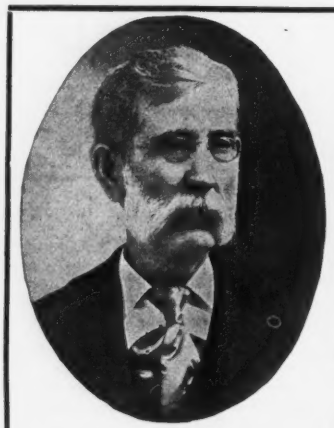

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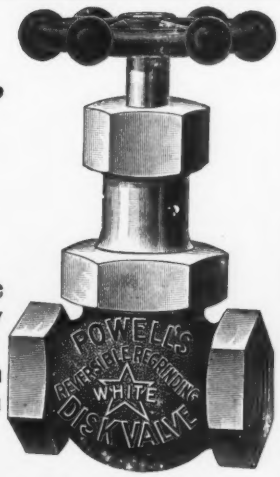

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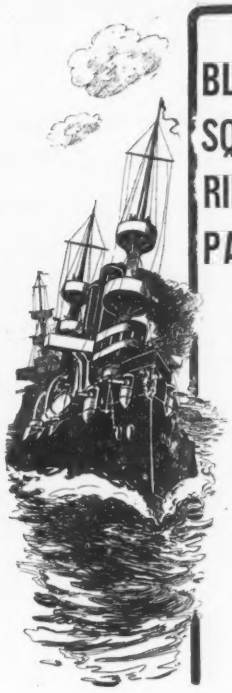

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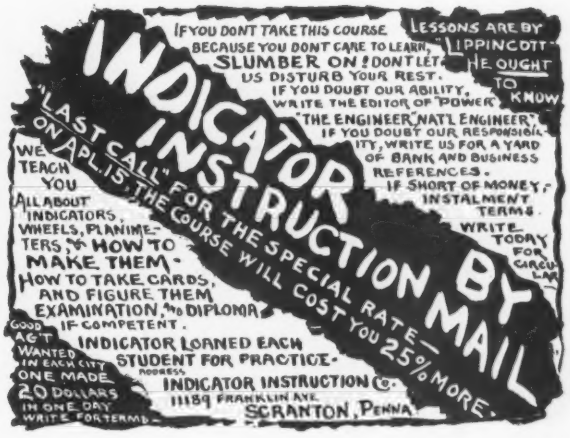
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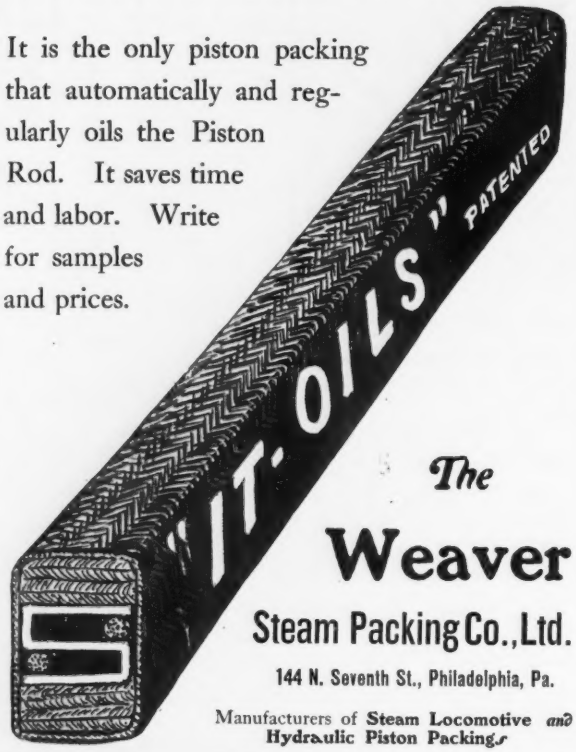

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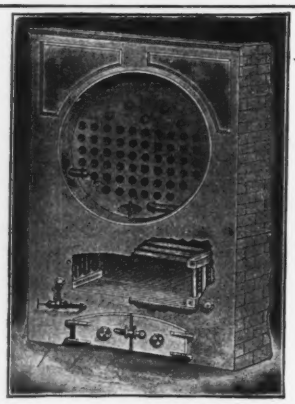

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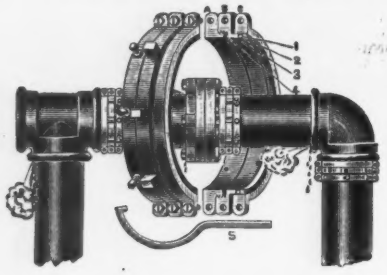

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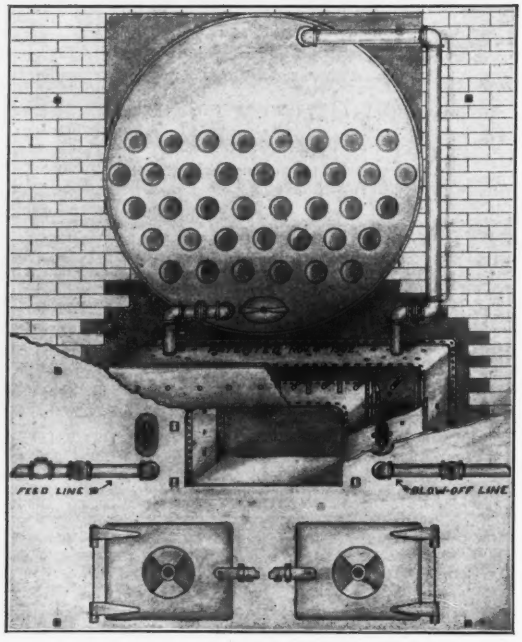

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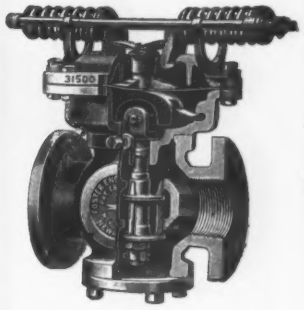

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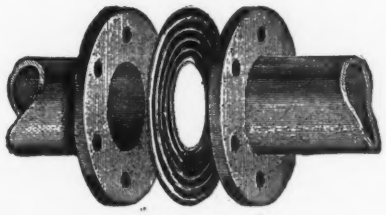

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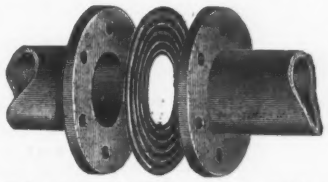

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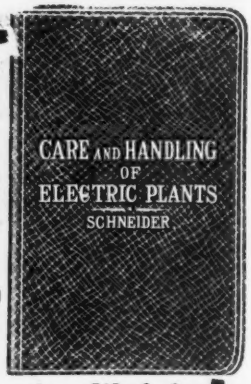

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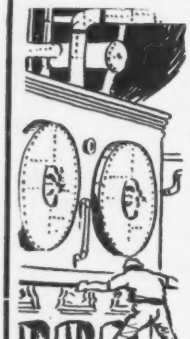

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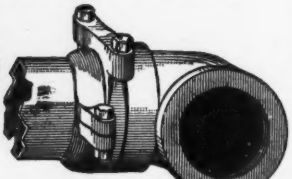

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W. CLIFFORD SMITH, Steam Specialties and CASTINGS of Every Description
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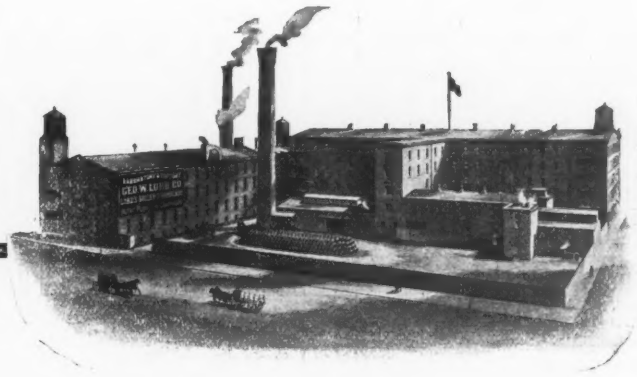


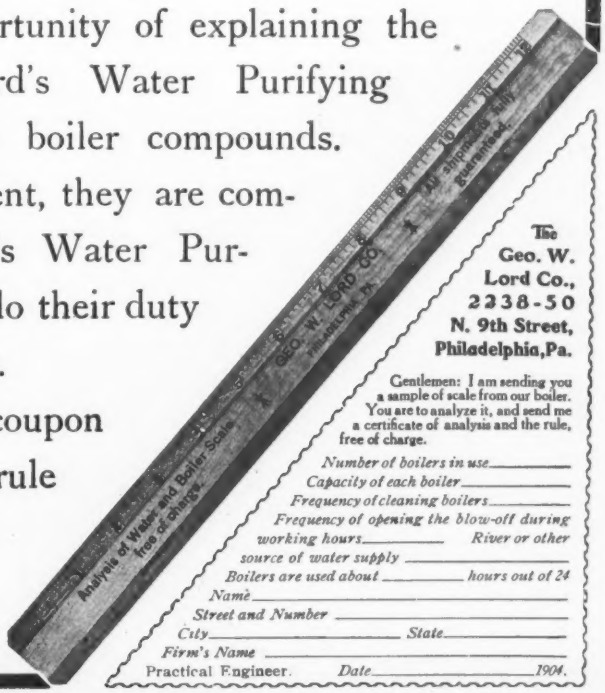
Works, Dauphin and Delhi Streets, Philadelphia, Pa.
The largest factory in the world devoted exclusively to the manufacture of Water Purifying Chemicals.

FREE FOR YOUR NAME

We want the name and address of every engineer, and in order to get them we will send a finely finished, beveled edge, inch and metric rule, one foot long, absolutely free to every engineer who will send us the coupon properly filled out, together with a sample of the scale from his boiler.

We want the opportunity of explaining the difference between Lord's Water Purifying Chemicals and ordinary boiler compounds. Although entirely different, they are commonly confused. Lord's Water Purifying Chemicals always do their duty and there's a reason for it.

Send the scale and coupon today, and receive the rule by return mail.



The
Geo. W.
Lord Co.,
2238-50
N. 9th Street,
Philadelphia, Pa.

Gentlemen: I am sending you a sample of scale from our boiler. You are to analyze it, and send me a certificate of analysis and the rule, free of charge.

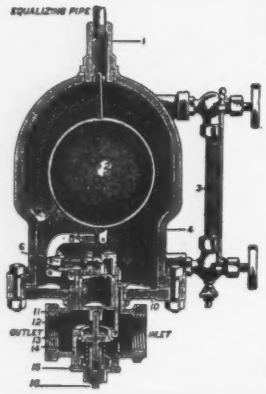
*Number of boilers in use*_____
*Capacity of each boiler*_____
*Frequency of cleaning boilers*_____
*Frequency of opening the blow-off during working hours*_____ *River or other source of water supply* _____
Boilers are used about _____ *hours out of 24*
*Name*_____
Street and Number _____
*City*_____ *State*_____
Firm's Name _____
Practical Engineer. *Date*_____ *1904.*

THE
H. H. Steam Trap

Has the most perfect seal of any Trap manufactured, making it impossible for the steam to escape, and is sold under guarantee to give satisfaction or we pay freight both ways.

If your dealer tells you he has some other make "just as good" —to say the least—he is not posted on the H. H.

JAMES McCREA & CO.
Manufacturers
67 W. Washington St. - CHICAGO



Bickel Float Steam Trap

HANDLING RUSHES OF WATER IS OUR HOBBY

This Trap is especially adapted for Separators. We also manufacture Thermostatic Steam Traps. Sent on 30 days trial to responsible parties.

SEND FOR CIRCULAR

FRED. L. BICKEL
1348 Palmer St., - Philadelphia, Pa.

ONE DEGREE

of heat opens and closes the valve in the

Heintz Steam Traps

Sensitive—extremely! But they last forever. Proof before pay.

Send for booklet "4"

William S. Haines Co.

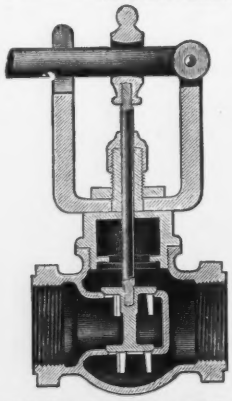
136 SOUTH FOURTH STREET, PHILADELPHIA

SPECIALTIES

Manufactured by **NASON MANUFACTURING CO., 71 Fulton St., N. Y.**

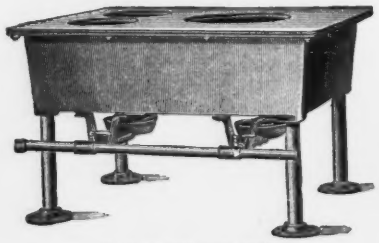
SEND FOR CATALOGUES

"NASON" STEAM TRAP
For Pressures under 70 Lbs.

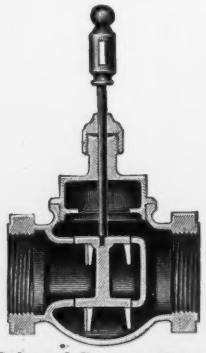


Quick Opening Balance Valve

STEAM GLUE HEATER



GAS GLUE HEATER

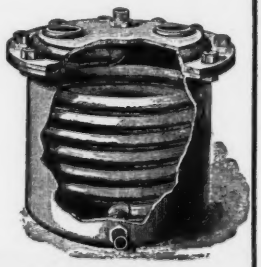


Balanced Governor Valve

"SIDELUG" STEAM TRAP
For Pressures 70 to 150 Lbs.

High Pressure Vertical Tube Radiator

HYDRAULIC VALVE



FEED WATER HEATER

Vegetable Treatment vs. Soda

When Vegetable Treatment is used direct in the boilers, the sulphates and carbonates of lime are converted into mud of a light nature, which is easily blown out through the blow-off daily and readily washed out when the boilers are opened. With Vegetable Treatment it is impossible to have any corrosive action due to the treatment itself or to any by-product which may be left as a result of the reactions, so that boilers are always kept in a clean, natural condition.

With Soda it has been the universal experience of steam users that it brings about a corrosive action in the boilers due to galvanic action; there are constant leaks around the steam joints, with white incrustation of Soda coming out; there is constant tendency for boilers to prime and foam, due to the saponifying action of the Soda, and the result, so far as cleaning boilers is concerned, is not nearly so satisfactory as when a properly compounded Vegetable Treatment is prepared for the individual case.

SEND GALLON OF WATER FOR ANALYSIS

Dearborn Drug and Chemical Works

WM. H. EDGAR, President
ROBT. F. CARR, Vice-Pres. and Gen. Mgr.
W. B. McVICKER, 2nd Vice-Pres. and East Mgr.
CHAS. M. EDDY, Sec. and Treas.
W. A. CONVERSE, Directing Chemist
ROBT. W. FRANCIS, Directing Engineer

MANUFACTURING AND ANALYTICAL CHEMISTS
CHEMICAL ENGINEERS

LABORATORIES AND WORKS - CHICAGO

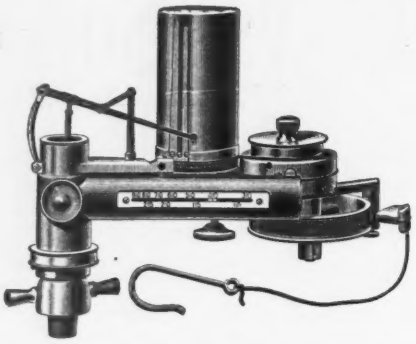
NEW YORK
120 Liberty Street

PHILADELPHIA OFFICE: THE BOURSE
G. F. Duemler, Mgr.

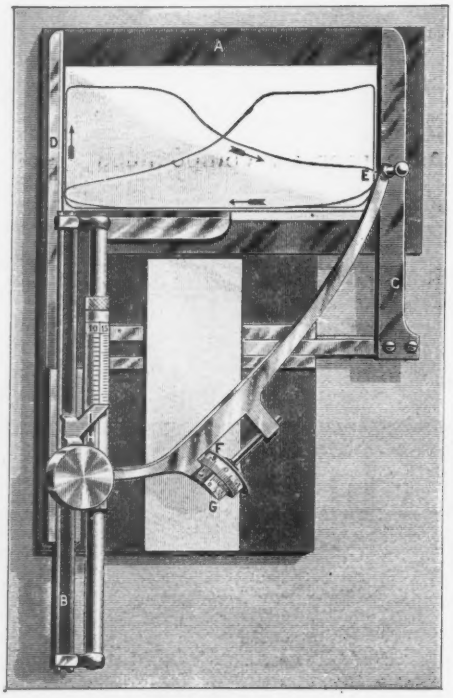
CHICAGO
27-34 Rialto Building

GUARANTEED SPECIALTIES

MOST COMPLETE OUTFIT MADE

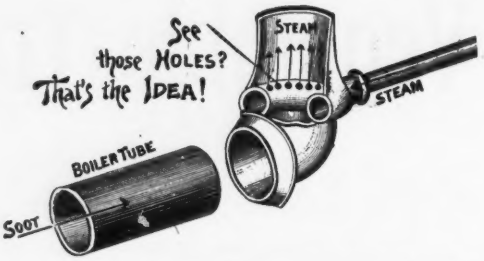


Bachelder Adjustable Spring Indicator, with Ideal Reducing Wheel attached.



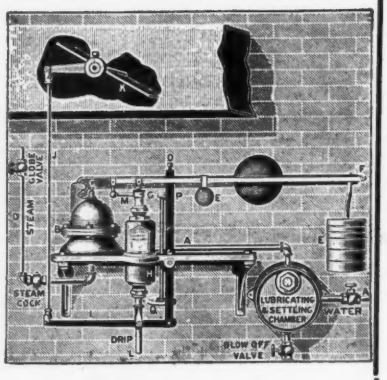
The Bushnell Planimeter figures both area and M. E. P. quickly and accurately.

Our Catalogue "A" describes a lot more. Send for it.

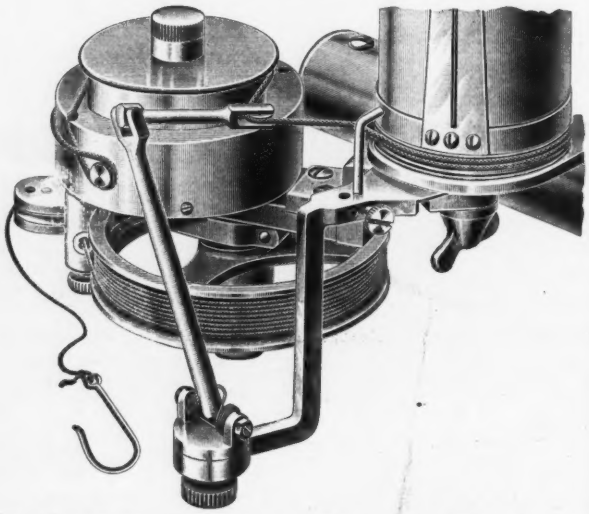


You can keep clean while you clean the tubes with the Soot Sucker Boiler Tube Cleaner.

Guaranteed to hold Steam Pressure within one half pound variation.



The old reliable Spencer Damper Regulator.



Bushnell Cord Take-up takes care of the slack cord and puts it back where it belongs.

JOHN S. BUSHNELL & COMPANY

126 Liberty Street :: :: New York, N. Y.

Garlock High Grade Packings

Are made specially in a hundred different styles, for every variety of service. They are superior for Steam, Gas, Water, Ammonia, Hydraulic, and for the satisfaction of those who use them.

GARLOCK PACKINGS are all made of the best material, on the latest improved automatic machinery, in the largest factories of the kind in the world, and by men of skill.

The Garlock Brass Wire Inserted Sheet Packing, No. 600

is the only packing that has successfully stood on marine vibrating joints; it is made of our celebrated sheet compound and a very fine weave of brass wire—it is utterly impossible for a joint made with this packing to blow out.

The Garlock High Pressure Ring Packing, No. 200

is the only fibrous packing that gives entire satisfaction on high speed and marine engines or locomotives, rods running in oil, grease or chemicals. Excels every other packing for expansion joints.

WE GUARANTEE ALL GARLOCK PACKINGS. WRITE FOR CATALOGUE.

Garlock Packing Company

604 Arch Street, PHILADELPHIA, PA.

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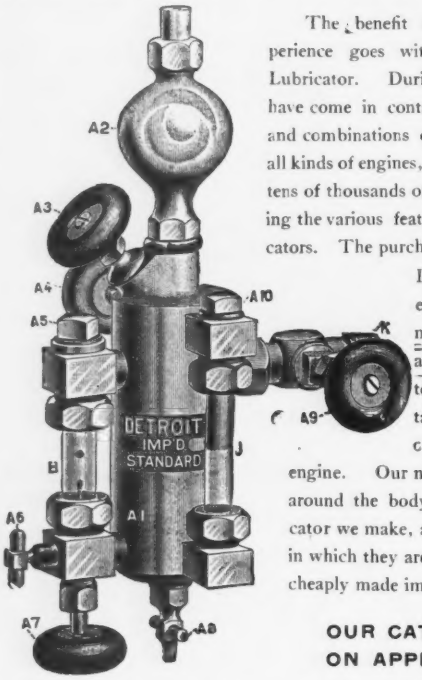
Main Office: PALMYRA, NEW YORK

THE EXPENSE OF EXPERIMENTING



The benefit of 25 years experience goes with every Detroit Lubricator. During that time we have come in contact with all kinds and combinations of conditions with all kinds of engines, and we have spent tens of thousands of dollars in perfecting the various features of our lubricators. The purchaser of a Detroit Lubricator has no expensive experimenting. He gets a standard guaranteed device and takes no chances of ruining his engine. Our name is stamped around the body of every lubricator we make, and on the boxes in which they are packed. Avoid cheaply made imitations.

OUR CATALOGUE ON APPLICATION

Detroit Lubricator Company, DETROIT Mich.

"You get your smoke"

Just read what an engineer says about

STEPHENSON BAR BELT DRESSING

Rochester, N. Y., Feb. 7, 1904

Stephenson Mfg. Co., Albany, N. Y.

Gentlemen: I received your sample and should have written you before but I waited for a chance to convince my employer that your Dressing is better than the liquids.

We have a two ton elevator.

I bet him a cigar I could load the car with Strawboard up to the crossbeam and the Dressing would talk for itself. He said, "that's a go". So I put on the load and told the boys to start her up. When she got to the top the boss looked at me and said, "you get your smoke."

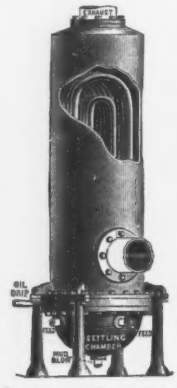
I am very much pleased with your Dressing. Have been engineering thirteen years, and it is the O. K. goods. I have saved your card and as the can of stuff is used up the boss says I can have some of yours.

Yours very truly,
A. KLIPFEL, Engineer.

Are YOU willing to be convinced that you are NOT using the best Dressing on the market, unless the name Stephenson is on each pound stick? If so, upon request we will send you a free sample if you mention this paper.

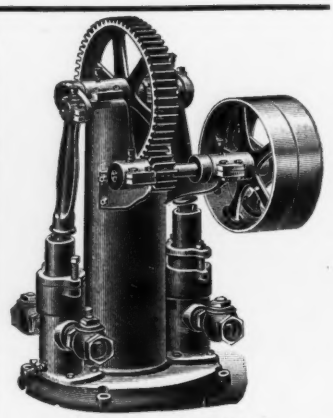
STEPHENSON MFG. CO.
ALBANY, NEW YORK

OUR BIG FOUR


Improved to date

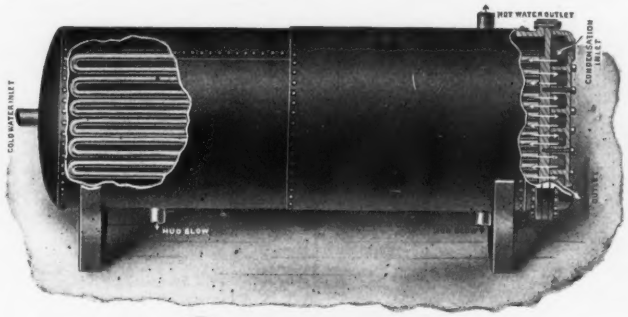
Improved to Date

Improved to date


Improved to date

If you are interested in modern steam plant ecenomy, you should investigate OUR BIG FOUR. The Patterson Specialties (Feed-Water Heaters, Exhaust Heads, Separators and Belt Pumps) are great money savers. Ask about the ones that interest you, we will be glad to answer your questions. Our proposition will pleasantly surprise you.

FRANK L. PATTERSON & CO.
24 CORTLANDT STREET MANUFACTURERS NEW YORK



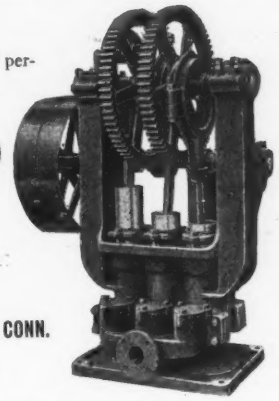
THE GLEANER
TRADE MARK

The **Gleaner** represents the acme of perfection in feed water heating.

THE

Davis Triplex Power Pump

is a perfect type of the vertical triplex belt driven pump.



MANUFACTURERS OF
The "Berryman" Feed Water Heater and Purifier.

I. B. DAVIS & SON, HARTFORD, CONN.

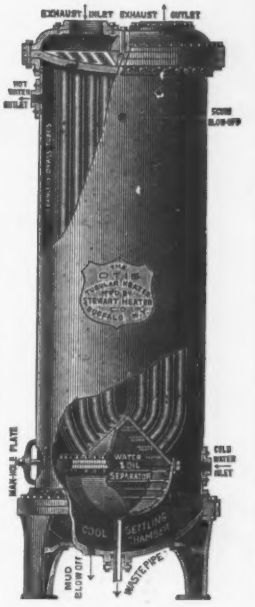
WRITE FOR CATALOGUE, ETC., TO

THOS. McADOO, 125 N. 4th St., Philadelphia

THE **OTIS** Tabular Feed

WATER HEATER, OIL SEPARATOR and PURIFIER

with Seamless Brass Tubes



Guaranteed

To heat the feed water to the boiling point (210 or 212 degrees) with the exhaust steam without causing any back pressure, **also to extract the oil from the exhaust,** so that the exhaust steam after being passed through the heater can be used for heating purposes, and the water of condensation for the heating system be returned to the boiler without the additional expense of an eliminator.

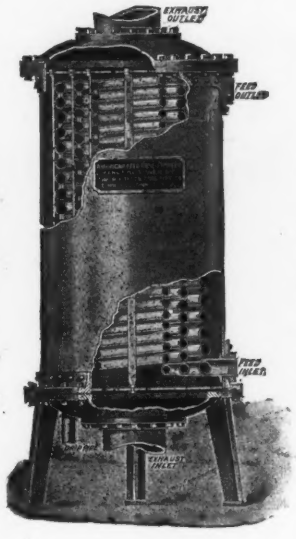
A Liberal Offer

If this heater fails to give satisfaction in every respect, we pay freight, cartage, etc., both ways.

The Stewart Heater Co.

11 Norfolk Avenue, Buffalo, N. Y., U. S. A.

THE AMERICAN STANDARD COPPER COIL FEED WATER HEATER



Simplicity!
Strength!
Economy!
A Money Saver!

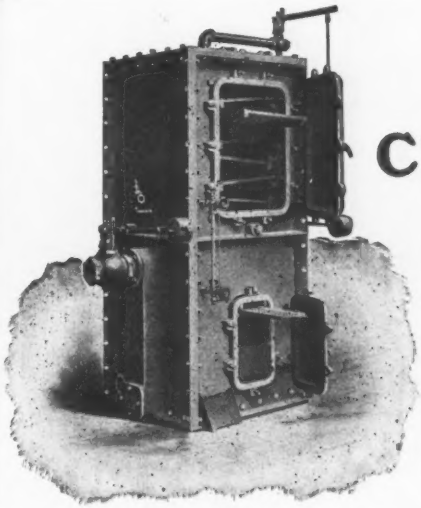
It gives so little trouble that one of our customers, who has used one for three years, had forgotten that he had it when we asked him the other day how it was doing. He called in the engineer, who said it hadn't been touched since it was put in and was still heating the water to 210 degrees.

That's the kind of a Heater you want.

Write for Catalogue No. 100 P

The Whitlock Coil Pipe Co.

HARTFORD : CONNECTICUT



In Chicago

The big Palmer House uses the Webster steam heating system, feed-water heater and separator. They didn't count on it for hot water service, though, — they thought the cylinder lubricants in the exhaust steam would spoil that.

Now they write that for four years the heater has furnished a full supply of purified hot water for the entire hotel, as well as kitchen and laundry. It not only removes all traces of oil, but of **lime** as well.

WEBSTER appliances do more than you bargain for.

WRITE FOR BOOKLET.

Warren Webster & Co.

CAMDEN, NEW JERSEY

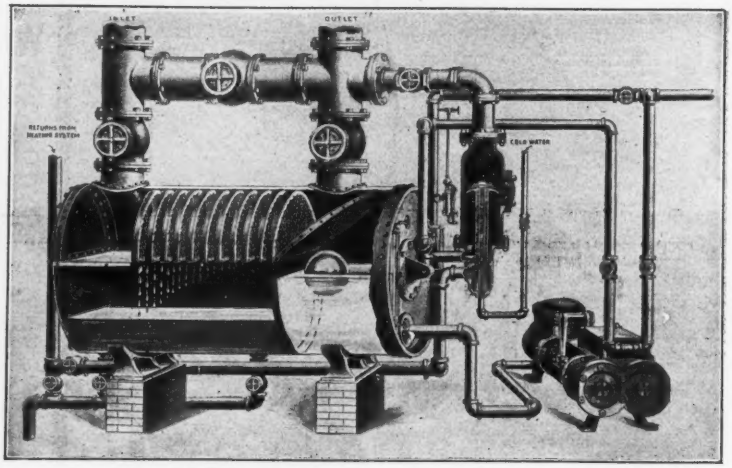
UTILITY STEAM SPECIALTIES

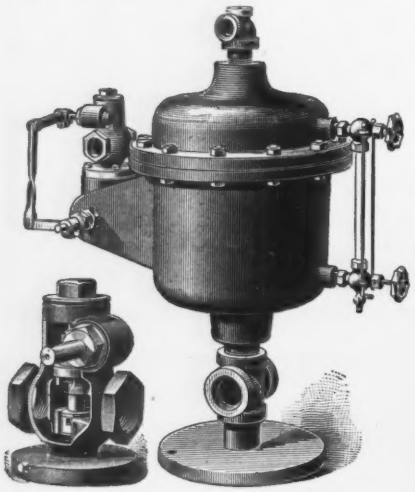
WE POINT TO WHAT WE'VE DONE AS PROOF THAT OIL CAN BE ENTIRELY REMOVED FROM EXHAUST STEAM AND THAT FEED WATER CAN BE HEATED ABOUT TO THE TEMPERATURE OF THE EXHAUST BY

Our "Utility" Combination

We can always guarantee an elimination of 98 per cent. at the outlet point af separator. We average over 99 per cent and have in some cases left but 8-10,000 of 1 per cent. of oil in the water. You can't see this amount, you can't taste it; fresh well water frequently has more oil in it, and this water can be used for fifty years in boilers without showing a trace of oil deposit. The feed water heating feature is optional, but very efficient, free from back pressure and requires but little room and no floor space.

The "Utility" Combination serves as Exhaust Muffler, Oil Separator, Return Tank, Pump Governor and Feed Water Heater. It costs only about as much as a Feed Water Heater.





"Utility" Pump Governor

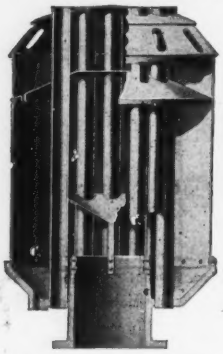
The best Pump Governor on the market. Why? Because our valve will not leak or stick; we guarantee it to absolutely govern the pump and remain tight for five years. Compare the construction of our valve with any other on the market. By adopting the "Utility" you can save coal and get a higher temperature from your heating or drying systems. Send for catalogue and list of users.

A New Application

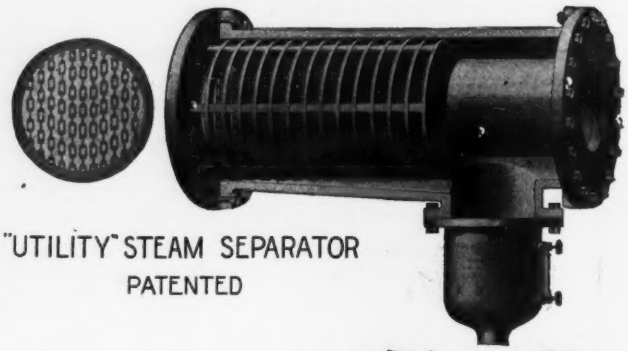
of the chain baffle plate principle which has proven so successful in the oil eliminator may be found in our

Steam Separator

and the efficiency of it is very high. Absolutely dry steam, absolutely no back pressure. What more could you ask?



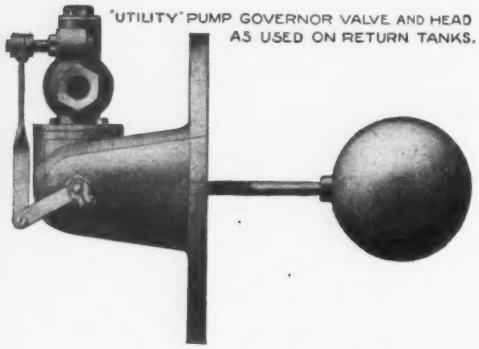
UTILITY EXHAUST HEAD
PATENTED



"UTILITY" STEAM SEPARATOR
PATENTED

Another Water Saver

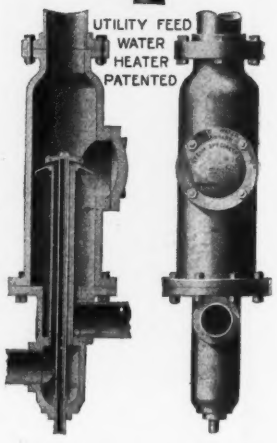
is our new Exhaust Head. Notice the great radiating surface that is given by the CIRCULATING AIR TUBES. These act as condensers, and they lessen instead of causing back pressure. Do you realize that a thousand gallons of water are wasted in a moderate sized plant which lacks an efficient exhaust head? It's so.



"UTILITY" PUMP GOVERNOR VALVE AND HEAD AS USED ON RETURN TANKS.

WE ALSO CARRY IN STOCK

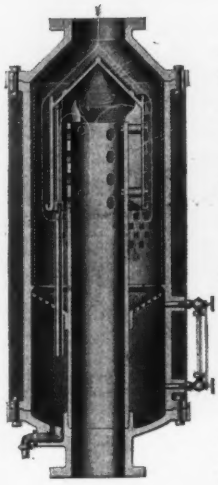
- Back Pressure Valves
- Blow-off Cocks
- Pressure Reducing Valves
- High and Low Pressure Boiler Feeders
- Reducing Pressure Reducing Valves
- Boston Boiler Thermostats
- Steam Traps
- Damper Regulators
- Feed Water Controllers
- "Utility" Beam Clamps



Standard Steam Specialty Co. 542 and 544 WEST BROADWAY
NEW YORK CITY

PHILADELPHIA OFFICE, ROOM 312, BOURSE BUILDING. BELL TELEPHONE, MARKET 44-95 A

Sweet's Separators



Our steam separators deliver steam containing less than one half of one per cent. of water.

Our oil separators remove 99 per cent. of the oil.

We can prove they do it and give good reasons why.

In addition they have size and are machines.

Made in all styles, also make Exhaust Heads and Steam Traps.

Direct Separator Co.

220 Marcellus Street

Syracuse : : New York

The Baum Separator

Horizontal Style for Live Steam or Oil Service.

For Live and Exhaust Steam
RESULTS GUARANTEED

For condensing systems use the BAUM VACUUM STYLE OIL EXTRACTOR.

Most satisfactory Separator on the market. Ask why.

The Baum Separator and Machine Company

Manheim, Pa., U. S. A.

Vacuum Style Oil Extractor.

Philadelphia Agents, ANERICAN SUPPLY COMPANY, 612 Betz Building

BERRYMAN

Feed Water Heaters and Purifiers

WATER TUBE AND STEAM TUBE

Cast Iron or Steel Shells. "U" Shaped Seamless Drawn Brass Tubes.

We Build Heaters for Every Purpose and Condition

THE KELLY PATENT

IMPROVED BERRYMAN WATER TUBE FEED WATER HEATER AND PURIFIER

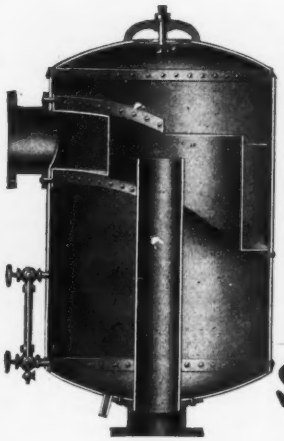
Benj. F. Kelly & Son - Makers

91 Liberty Street, NEW YORK

DID YOU EVER THINK

THAT BY USING A WELL DESIGNED AND PROPORTIONED STEAM RECEIVER AND SEPARATOR

YOU COULD



Patent Allowed

OVERCOME entirely any chances of damage to your Engine by water throwing over with the steam.
SECURE better cylinder lubrication with less oil.
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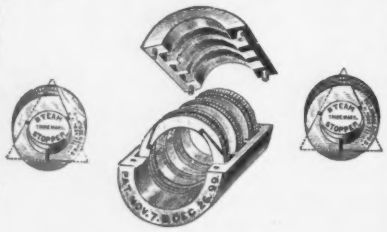

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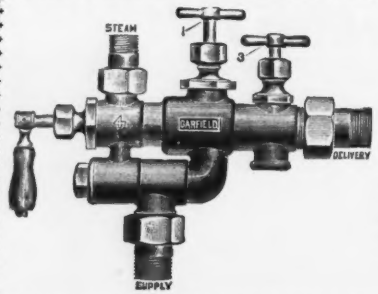

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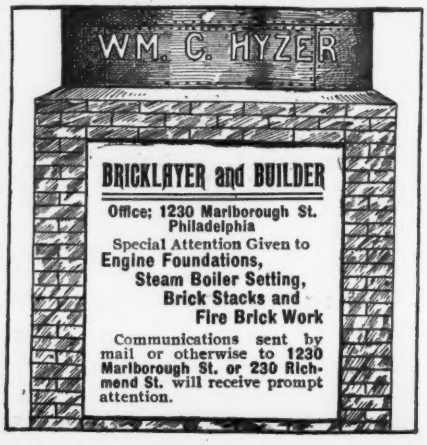
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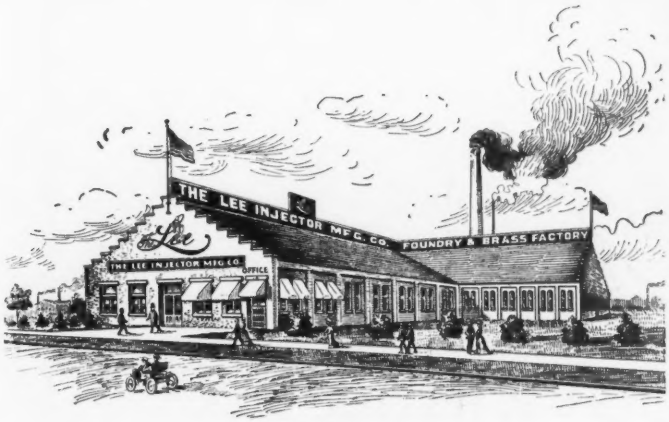

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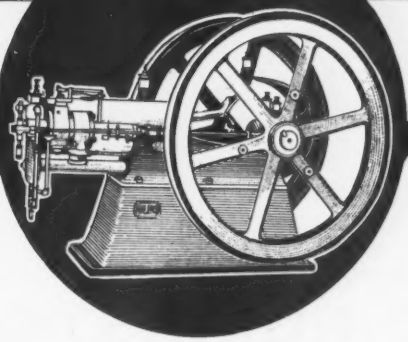

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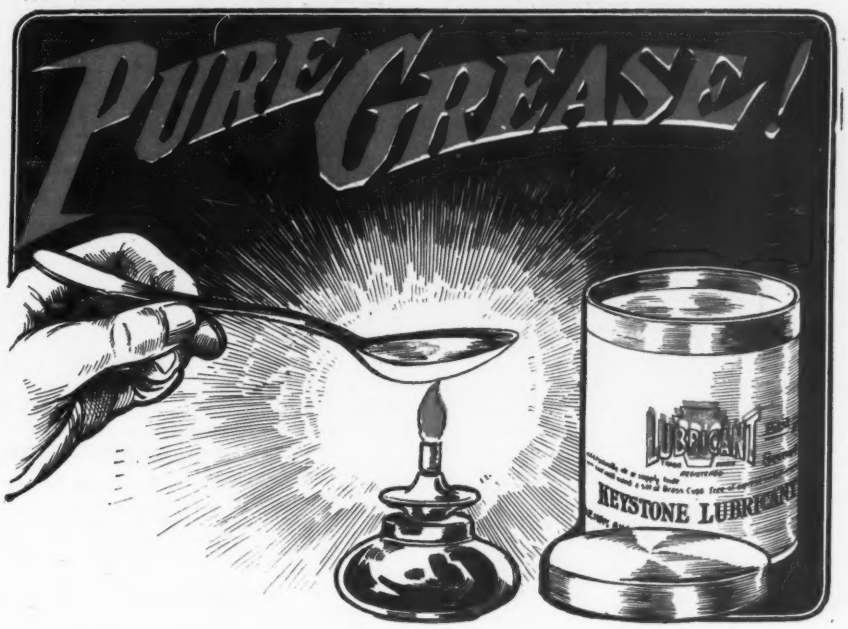

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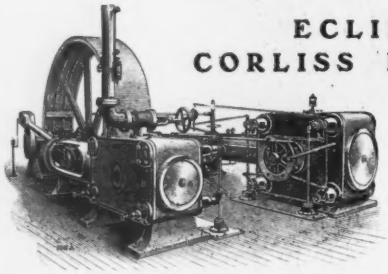

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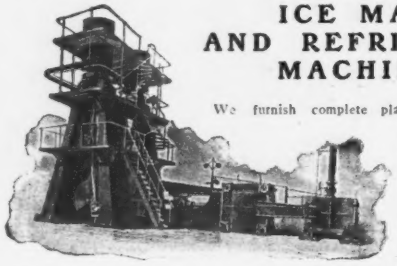

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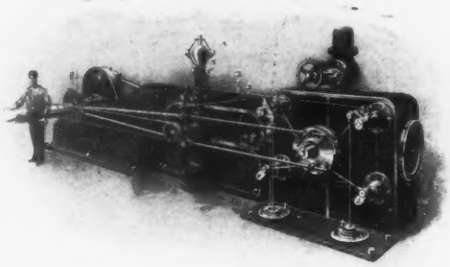

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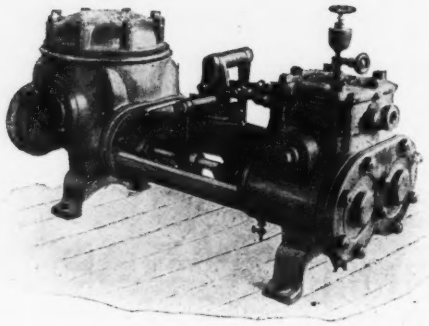

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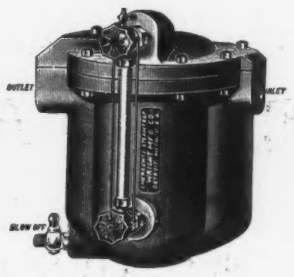

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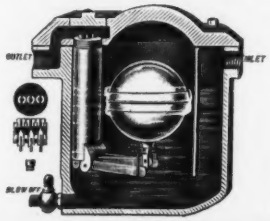

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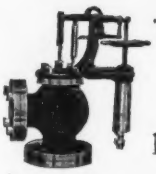

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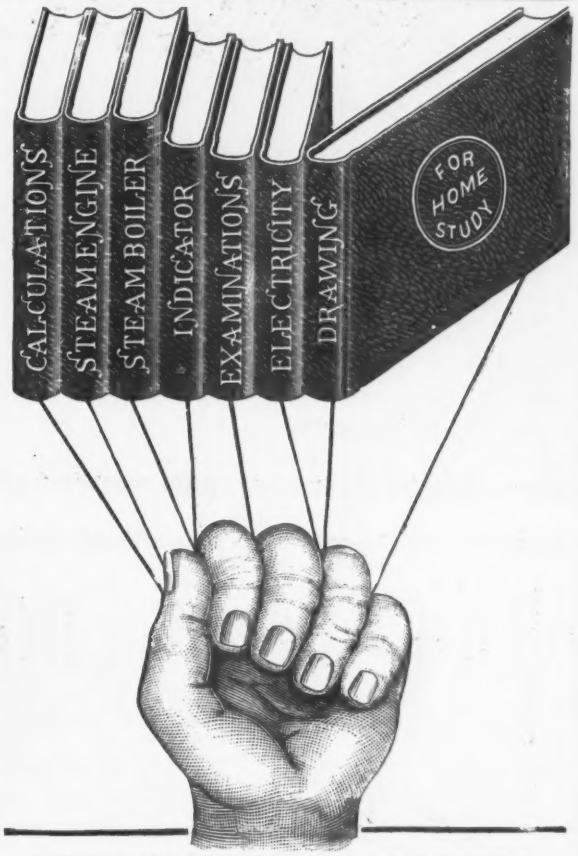

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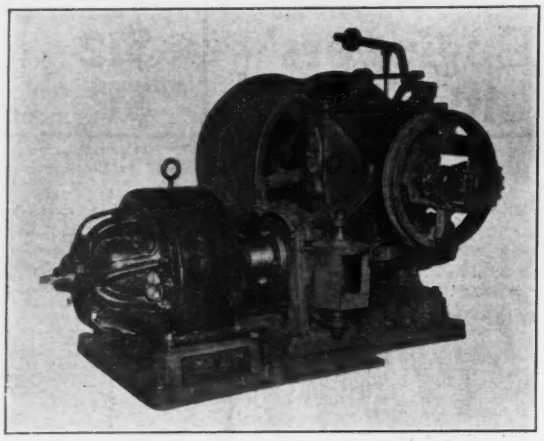

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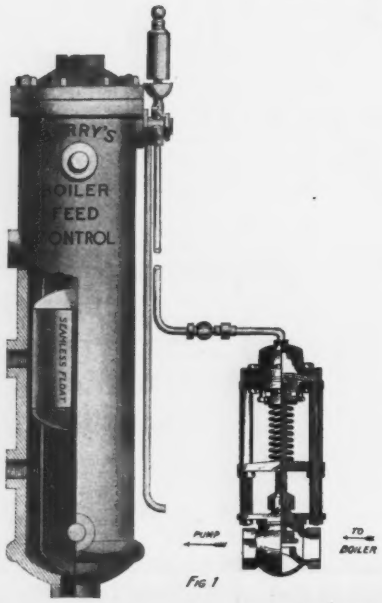

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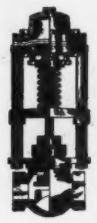

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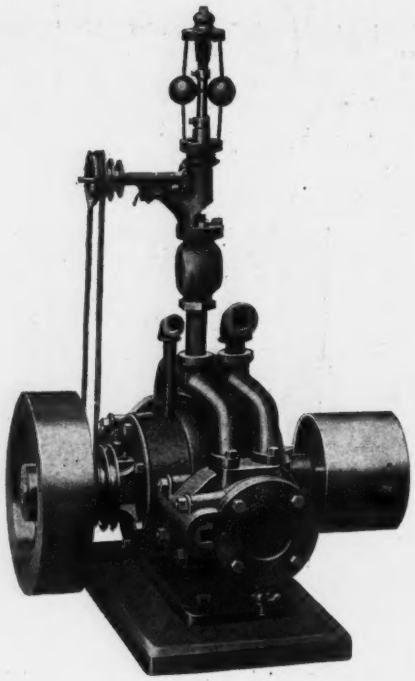

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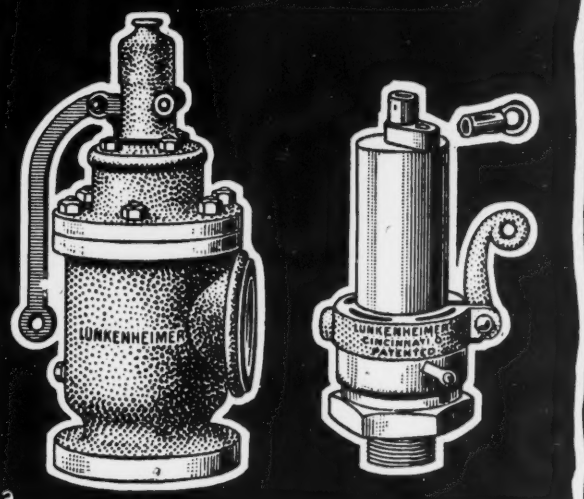

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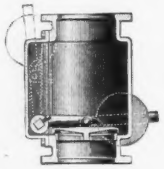

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keep on hand a box of JENKINS GASKET TUBING and you will have a gasket always ready. It is made from a compound similar to the Jenkins '96 Packing, and is guaranteed to make a perfectly tight and lasting steam joint. Made three-eight inch, one-half inch, five-eight inch, and three-fourth inch in diameter, in lengths of about 12 feet; packed in boxes holding 4 to 6 pounds, and each box also contains a supply of plugs and tape.

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